Dawson Creek
Timber Supply Area

Documentation of
Vegetation Resources Inventory
Interim Analysis

PREPARED BY:

MINISTRY OF FORESTS
RESOURCES INVENTORY BRANCH

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Dawson Creek Forest District:
- Winn Hays-Byl
- Rod Kronlacher

Prince George Region:
- Matt Makar
- Dick Nakatsu

Timber Supply Branch:
- Chris Fletcher
- Ian Graeme

Resources Inventory Branch analysis team:
- Lawrence Bowdige
- Rob Drummond
- Edward Fong
- Gary Johansen
- Alf Kivari
- Bob Krahn
- Kelly Loch
- Colleen McKendry
- Sam Otukol
- Will Smith
- Keith Tudor

Contractors:
- Gitte Churlish
- Karen Jahraus

Executive Summary

This report documents the Vegetation Resources Inventory (VRI) preliminary analysis that was completed for the Dawson Creek Inventory Unit in anticipation of the Timber Supply Review (TSR) II in 2000. The report was developed in conjunction with Ministry of Forests staff from Resources Inventory Branch, Timber Supply Branch, the Prince George Region, and the Dawson Creek District.

The report references and contains content from the previously developed "Dawson Creek Forest District Vegetation Resources Inventory Ground Sampling Plan: Revised Final Report, October 1997".

This analysis focussed on the development of adjustment factors for height, age and volume to support the current timber supply analysis. The process used to derive these adjustments is interim and may change in the future.

Additional ground sampling is taking place in the 2000 field season. There is an expectation that the analysis will be redone in the fall of 2000 to incorporate this new data and any new analysis procedures.

Based on a population of interest defined as the vegetated, treed portion of the timber supply area, the overall results indicated a ground volume to inventory volume ratio of 1.05 for coniferous stands and 1.33 for stands leading in trembling aspen or poplar. This can be interpreted as indicating that inventory volumes may be underestimated by 5% on average for coniferous stands, and 33% on average for stands leading in trembling aspen or poplar.

The information in this report will be considered by Timber Supply Branch in the upcoming timber supply review.

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1 Introduction

1.1 Purpose

This report was assembled to provide a detailed description of the procedures and assumptions that went into the preliminary analysis of the Dawson Creek TSA Vegetation Resources Inventory data and to document the results to date.

The primary purpose of this report is for documentation. Stakeholders in the Dawson Creek TSA must review this report and determine how best to use the results contained herein.

1.2 Background

The primary drivers for initiating a Vegetation Resources Inventory project in this management unit were the age of the Dawson Creek TSA inventory and the results indicated by the 1995 Inventory Audit of this unit. Results from the Inventory Audit indicated that the mature timber component volume of the Dawson Creek TSA was under-estimated by approximately 19% on average. Details on the audit results can be found in Appendix A-1. In addition, there was uncertainty around the merchantability of old-growth spruce, balsam, and mixed balsam and spruce stands, mixed-wood and pure deciduous stands, and height class 2 pine stands.

In October of 1997, a Vegetation Resources Inventory Strategic Plan (VSIP) was prepared for the Dawson Creek TSA. The objective of this strategic plan is to identify forest management issues and methods by which the Vegetation Resources Inventory (VRI) program can address these concerns. Forest management issues in the District included: improved estimates of overall net timber volume inventory; biodiversity guideline levels (coarse woody debris); site index estimates; site index-BEC correlations; and provision of data for criterion indicators. The area considered in the VSIP covered all TSA, TFL, private, park, and reserve land within the boundaries of the District.

The VSIP outlined two primary objectives for data collection. The first objective was to implement VRI Phase II ground sampling in the Dawson Creek Inventory Unit to:

a) estimate overall vegetation totals and averages for the District. This data will be used in Timber Supply Review (TSR) II analysis.

b) provide initial conditions for measuring indicators of sustainable management

c) provide a framework for sub-unit inventories.

The TSR analysis that the VRI data from this project is to be incorporated into, has the following tentative key dates:

Information package completion:	January 2000
Database analysis:	February 2000
TSR analysis:	March to August 2000
Timber Supply determination by Chief Forester	December 2001

The second objective was to conduct supplemental decay sampling across the District to estimate merchantability (net volume and value) of specific old-growth forest types identified by the MOF and the licensees. These forest types include old-growth spruce, balsam, and balsam/spruce stands; mixed-wood and pure deciduous stands; and height class 2 pine stands. These stands constitute about 66% of the forest area in the District.

The objective of Net Volume Adjustment Factor (NVAF) sampling is to improve estimates of tree net volume from the net factoring process. This is accomplished using stem analysis to provide local estimates of decay and tree taper. The data from stem analyses are used to develop a factor (NVAF) to adjust the net volume from the Phase II ground sampling (derived from the net factoring process and taper equations). The basis for the method used to calculate the NVAF, is the estimation of the actual net volume of felled trees. The NVAF sampling unit is the tree. The attributes of interest are actual merchantable volume per tree and actual percent sound wood of the merchantable volume.

To date, accomplishment of the first objective is nearing completion. The second objective, to carry out decay sampling using Net Volume Adjustment Factor (NVAF) procedures is tentatively scheduled to complete in field season 2000.

The original VSIP recommended a total of 330 ground sample plots be established, 190 of which were to collect full VRI data and 140 of which were to collect timber emphasis data only. The sample size was determined to provide a 10% sampling error for net volume at the 95% level of probability for the entire vegetated and non-vegetated landbase in the District. The original recommendation of 330 plots was revised to 300 (see section 2.4 for details and Appendix A-2 for the list of 300 samples).

In the 1998 field season, 60 sample plots were established in the District (including some in TFL 48). After these samples had been collected, the stakeholders reassessed the business needs in the District and determined that the available resources should be reapportioned to the vegetated, treed portion of the TSA only (i.e. ownerships 62C and 69C only; excluding TFL 48). A revised ground sampling plan was developed in which two strata of interest were identified:

1. Trembling aspen and poplar leading polygons
2. Coniferous leading polygons

The objective was to provide 10% sampling error for net volume (at the 95% level of probability) overall in the TSA. The district's expectation was also to achieve 15% sampling error (at a 95% probability level) in each of the two primary strata of interest. The sample size to achieve these targets was not calculated. Final sampling, to be carried out in 2000, will depend on the statistical results for the data collected in 1998 and 1999.

The results of the sampling carried out under the revised ground sampling plan form the basis of this document. Note that the revised ground sampling plan also reflected the

stakeholders' decision to develop a separate management unit ground sampling plan for TFL 48[1]. Hence, this report does not present results for TFL 48.

A further amendment to the revised ground sampling plan specified that an additional 50 samples in the aspen/poplar strata were to be established in the 2000 field season. Analysis of this new data is expected to take place in the fall of 2000.

1.3 Description of the Inventory Unit

The inventory unit for the Dawson Creek Vegetation Resources Inventory (VRI) is the entire landbase within the administrative boundaries of the District (see Figure 1). The District covers approximately 3 million ha and is located in the Prince George Forest Region, between the Continental Divide and the Alberta border. The area includes the Dawson Creek TSA, TFL 48, a portion of the Kakwa Recreational Area, Monkman Provincial Park, Gwillim Lake Provincial Park, Sukunka Falls Provincial Park, Federal land, Williston Lake, and private lands. TFL 48 occupies approximately one-third of the District area. Approximately 74% of the District is considered productive forest land. The remaining areas include non-forest and non-productive land (approximately 26%), and land with no typing available (less than 1%). According to the most recent timber supply review, about 33% (758,609 ha) of the Timber Supply Area was considered available for timber production.

[1] In addition to the TFL 48 ground sampling plan, there are a number of other VRI related projects in the Dawson Creek TSA. These include the ongoing Phase I retrofit for the Red Willow Landscape Unit. This is a licensee (Canfor) led project. To date, the classification has been completed and the project is scheduled for completion by early 2000. Objectives of the project include collection of data for management of cariboo habitat. Another related VRI project is the ongoing Phase I update of the TFL 48 inventory. To date, approximately 118 mapsheets have been updated (Rod Kronlachner, Pers. Comm. 2000).

Figure 1: Map of the Dawson Creek Forest District

2 Sample selection based on original ground sampling plan

2.1 Limitations of the sampling process

No new Phase I data was available for this inventory unit, so the existing inventory information ranging from 1983 to 1997 was used. Updates were completed between 1988 and 1991. Five mapsheets were updated in 1997.

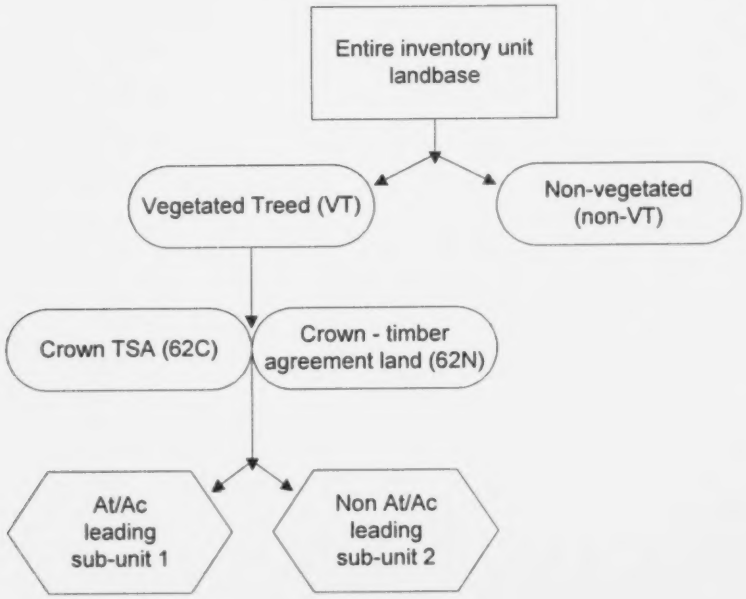
Between the time of the sample selection and analysis, some mapsheets were reinventoried via updated photo interpretation as part of the Moose Lake reinventory project. This resulted in changes to polygon boundaries, which in turn impacted the attributes associated with the location of some ground sample plots when sampling crews utilized the newer photography. Ten mapsheets were reinventoried (93P 005, 006, 015, 016, 024, 025, 026, 034, 035, 036) while the Phase II Ground Sampling Phase was in progress. Out of the total number of mapsheets (approximately 250) this represented only 4.0% of the total area.

To determine the potential impact of this partial reinventory, it was intended that an analysis would be done to compare the results based on the inventory at the time of sample selection with the results based on the current inventory (including the reinventory data for 10 mapsheets). However, this was not possible in the time frame available. As an alternative, the impact was assessed by comparing the two populations (see section 4.3 for results of this assessment).

2.2 Inventory sub-unit creation

The entire inventory unit was first split into Vegetated Treed (VT) and other (i.e. non-vegetated (N) and vegetated non-treed (VN)), and then within the VT, according to ownership, the crown TSA portions (62C and 69C) and Timber agreement land (62N) were split out. Within this crown level, one sub-unit was created for trembling aspen/poplar (At/Ac) leading, and one sub-unit for non-At/Ac leading. This is illustrated in Figure 2 below.

Figure 2: Dawson Creek Inventory Sub-unit Creation



2.3 Data assembly process and database constraints

Data assembly was initiated in 1997 with Resources Inventory Branch staff creating the project database by collecting all Forest Inventory Program (FIP) and Forest Cover (FC1) files for the Dawson Creek district. The data in these files was in both NAD 27 and 83, so adjustment of the NAD 27 files to NAD 83 was first completed. Where the new alignment created gaps in information, a data record with landbase area was included. Where overlaps occurred, the NAD 83 data was used in the database. Following this, all files were merged into one spatially correct, Geographic Information System (GIS) database using PAMAP software. Final correction for errors in boundary locations was also done.

Upon completion of the database creation for the entire District, it was noted that the no crown closure (CC) data existed for the TFL 48 portion of the inventory unit. Crown closure is a critical attribute used to classify polygons as vegetated treed (VT) or other (i.e. N or VN) under the BC Land Cover classification System (BCLCS). Given the missing crown closure data, a data fix was designed to replace the crown closure with VT for records where the following conditions were met:

a) CC=0;
b) Species was not equal to blank; and.

c) Projected age was greater than or equal to 20 years.

Other database corrections were made to address split polygons. These occurred either after appropriate overlays (e.g. BEC, ownership) were applied to the forest cover polygons, or when the inventory unit boundaries were adjusted to accommodate the shifting of the NAD 27 polygons. Where forest cover polygons were split, overlay attributes (e.g. BEC information layer) were assigned to all split polygons based on those attributes that coincided with the largest portion of the original forest cover polygon.

2.4 Data sorting criteria

The objective was to sort the spatial database hierarchically by land cover classification for vegetated treed (VT) versus other (N, VN), and then further within the VT classification based on leading species, projected age, site index, and crown closure. However, these sorting criteria were not used in the Dawson Creek project. Appendix A-10 outlines the data sorting and sample selection procedures that occurred.

2.5 Sample selection procedure and sample selection issues

The original VRI ground sampling plan for the Dawson Creek inventory unit initially specified a total of 330 ground samples based on a coefficient of variation (CV) of 40 – 80% with a target precision for timber net volume of +/-10%. 250 samples were to be located within the vegetated, tree (VT) and 80 samples in the remaining non-vegetated, tree areas.

In the fall of 1998, the original ground sampling plan was revised. Stakeholders decided to focus on the vegetated, treed portion of the TSA and a licensee funding the project specified a need for data in the trembling aspen and poplar (At/Ac) strata. The number of samples required for this strata were then determined by reviewing the inventory audit data and selecting the number of samples required to maintain the target sampling error.

The process to select the required ground samples was to first systematically draw 10,000 potential samples from the sorted list that includes all polygons in the district. From this list, 330 samples were then systematically selected. However, given the TFL 48 crown closure data issue (see section 2.3), the proportional sampling area in each of the VT and non-VT had to be adjusted. This resulted in a reduction of the number of required samples from 330 to a total of 300. This adjustment also required the locating of more samples proportionally within the TFL 48 area, and fewer samples outside of TFL 48.

The samples required for the two strata identified in the revised 1998 ground sampling plan were obtained from the original 300 samples.

Another correction that was carried out after the ground sampling had started, was adjustment on 4.3% of the total inventory area for samples located on incorrectly numbered mapsheets. This involved five samples which were then not used in the VRI analysis. Five replacement samples were subsequently relocated and sampled on the correct mapsheets, and the data from these was included in the VRI analysis.

Additional details on data sorting and sample selection for Dawson Creek are provided in Appendix A-10.

3 Data Collection

3.1 Description of data collection process

Phase II ground sampling was initiated in 1998 and continued in 1999, with a target for ground sampling completion in 2000. When the ground sampling plan was revised after the 1998 field season, some of the 60 samples collected in 1998 did not meet the new population of interest criteria. As a result, not all of the 1998 samples were used in the preliminary VRI analysis documented in this report. Final sampling for the field season 2000 will be dependent on statistical results from sample data collected to date; 50 additional samples in the aspen/poplar strata are currently planned.

NVAF sampling is also tentatively scheduled to complete in field season 2000. To date, the cruise, Step One phase of the NVAF has been completed on 28 samples; 15 in the deciduous sub-unit and 13 in the non-deciduous sub-unit. Additional cruising may be required (Will Smith, Pers. Comm. 2000). Completion of the sample list to carry out the Step Two phase (destructive sampling) for this project is in progress.

The data was collected according to VRI standards for timber, full VRI and coarse woody debris. Since this data was collected over the 1998 and 1999 field seasons, both the 1998 and the new 1999 data collection card formats were used.

3.2 Contractors involved in data collection

VRI certified crews were used to collect the data following the appropriate VRI *Ground Sampling Manual*. Two forest contracting firms carried out the ground sampling in the 1998 and 1999 field seasons: IFS (Industrial Forestry Service Ltd.) based out of Prince George, and Chiltech Forestry Ltd. based out of Williams Lake.

3.3 Description and results of the cruise audit process (Quality Assurance): 1998-99

The cruise audit process assessed the quality of the field sampling data collection. A target measurement error of +/- 15% for value (when ground volumes were compared with audited ground volumes) was set for the project. This level of acceptable measurement error provides some indication for the forest manager using the data, of the possible range around the attribute (ie: net volume).

1998:

Quality assurance (QA) was carried out for 45 timber emphasis samples. Five samples were checked, two by MOF staff and three under a QA contract. All samples passed.

The most notable errors (Matt Makar, Pers. Comm. 2000) were the following:
a) inclusion of an extra tree on one sample;
b) training issue as to when the mapped location of the IPC is to be used to assist in determination of when an auxiliary plot is out of the polygon;
c) inconsistency among some height measurements.

1999:

Quality assurance was also carried out for 110 samples established in the field season of 1999.

Fourteen samples were checked and the majority were well done (M. Makar, Pers. Comm, 2000). The twelve QA samples checked were the following:

4 timber only checks of 3 "timber only plots (TEP)"

4 timber only checks of 3 "full VRI plots"

2 ecology only checks of 2 "ecology only plots"

3 full checks (timber and ecology) on 3 "full VRI plots"

1 timber + Coarse Woody Debris (CWD) check on 1 "full VRI plot"

All but one ecology sample passed (one failed on errors in sampling the coarse woody debris attribute), and all timber emphasis samples passed.

The most common timber sampling errors were missing data (eg: the occasional missed field on the cards) as well as a procedural problem where the crews would measure trees out, but not cross off the data collected for these trees. This would result in a higher tree count, which was fortunately easily corrected in the office.

For one full VRI plot a correction for the spruce in this ESSF area had to be made from Spruce (S) to Englemann Spruce (Se). For one TEP sample, crews were notified to improve their species identification from Spruce (S) to White Spruce (Sw) and Black Spruce (Sb) as found on site.

The most common Ecology sampling errors were with CWD procedures. Initially the crews were missing suspended CWD as well as the occasional piece on the ground, but this improved over the project. There were also a few samples where the number of shrubs, herbs and bryoids tallied were close to the tolerance levels required to pass the QA process.

3.4 Inaccessible samples and remedial measures taken to mitigate the effect of the missing data

On the Dawson Creek project, very few samples were considered inaccessible. Of the total number of samples to be collected, three were given this status after preliminary review; one due to a bear problem, one due to active blasting in a mine site, and one due to problems with access.

All three are to be reviewed to see if sampling at a later date could allow a crew to collect the required data. If this is not possible, replacement plots will be located as required.

3.5 Identification of other data collection issues that could influence inventory results

A few minor issues that impacted the sampling are the following:

a) One crew did not locate the sample correctly resulting in the sample falling outside of the designated polygon. This sample could not be included in the final

analysis. It is interesting to note that this crew did not utilize the real-time GPS to navigate to the sample.

b) Some crews used real-time Global Positioning System (GPS) to navigate to samples and this improved the overall location of plots for the project. The use of this technology emphasized the requirement for sampling crews to have enhanced GPS skills, and it is recommended that this be addressed through the provision of GPS training for contractors sampling on VRI projects.

4 Data editing and cleaning

4.1 Data entry and compilation processes

A total of 109 samples in the VT portion of the Dawson Creek TSA were completed and compiled for this analysis. Since this data was collected over the 1998 and 1999 field seasons, both the 1998 and the new 1999 data card formats were used.

Ground sample data was entered using the VRI data entry tool and validated in the VRI Oracle database (see section 4.2 for a description of data changes). An ascii flat file from the database was provided for compilation in the VRI compiler.

4.2 Pre-analysis data editing

The following data issues were identified:

1. *Dropped sample:* Sample 4 was dropped because the GPS coordinates for the sample fell outside the boundaries for the target polygon. The point from the map was transferred incorrectly onto the photo.
2. *Prorated ages:* There were a relatively large number of trees in the Dawson Creek VRI project that had prorated age data because of rot. Typically, such trees are not considered "suitable" for age estimation. For many samples, average age was either not available or was based on a relatively small number of trees.

In an effort to improve the age information available for analysis, the project team decided to include all prorated age count data in the determination of true ground age. The prorate age data uses a basal area increment function to determine missing and intact age cores.

As a result, about 30 of the samples in the 1999 format required data changes[2]. The majority of the changes involved the "Suitable Age" information. Where a tree had prorate data as a result of rot as the "measure code", the "suitable age" was changed from "N" to "Y". The data was then recompiled to include the ages for these trees in the average reported ages. Note that the data changes related to prorated age were only made on the "flat file" used for compilation purposes; no changes were made to the permanent version of the data in the Oracle database.

There were also a number of data changes and/or assumptions made that were directly related to the analysis of the data. These are discussed in section 5.2 and documented in Appendix A-3.

[2] E-mail from Bob Krahn, December 2, 1999 detailing changes.

4.3 Changes to the photo interpreted data between the time of sample selection and analysis

The inventory attributes for this analysis were based on the FIP file data assembled for the original sample selection. It was originally intended that a comparative analysis using the current inventory files (including 10 reinventoried mapsheets; see section 2.1) would also be completed. However, this was not possible in the time frame available.

Areas in the VT portion of the inventory were compared between the 1997 selection file and the 1999 current inventory file. Across various strata (leading species, TSA vs. TFL, etc.), area differences were all less than 2%. Hence the impact of the updates to the inventory files between the time of sample selection and analysis were assumed to be negligible.

All analysis presented in this document was based on the inventory file at the time of sample selection.

5 Statistical adjustment of attributes

5.1 Overview

The analysis of the Dawson Creek VRI data used the current approach for adjustment of inventory attributes, referred to as the "Fraser Protocol"[3]. Note that the "Fraser Protocol" is an interim process for satisfying Timber Supply Review (TSR) needs. A more comprehensive and long-term process for adjustment of inventory attributes is under development.

In the "Fraser Protocol", the statistical adjustment of inventory attributes consists of a set of steps and assumptions used to develop and then apply adjustment factors to the FIP file attributes of height and age and the volume predicted using VDYP. The goal of the adjustment is to remove any overall bias in the inventory when compared against the VRI ground data for the attributes that are adjusted.

The steps in this adjustment process are outlined below:

1. Adjust height and age.
2. Based on the adjusted height and age, use VDYP to computed inventory volume.
3. Use the compiled ground volumes to then adjust this "attribute-adjusted" inventory volume.

Details of this process are described in the sections that follow.

5.2 Population for adjustment

The population for adjustment was defined as all vegetated, treed polygons[4] with ownership 62C or 69C[5]. No minimum age criterion was applied. A second population of interest was also defined. This represented a slight modification of the basic VT polygons with 62C or 69C ownership – all samples classed as non-productive forest (type identification = 6) were excluded in this second population of interest.

Two sets of adjustment factors were developed, one for each of these populations of interest. ***Please note that all statistics provided in the body of this report are based on a population of interest that includes polygons classed as non-productive forest (i.e. type id 6 is included).*** The adjustment factors for the second population of interest, excluding polygons classed as non-productive forest, are provided in Appendix A-4.

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[3] Ministry of Forests. Fraser TSA: File Adjustment Project. File adjustment recommendations. MOF ORCS 13300-20tsaadjmt. April 15, 1997. 10p.

[4] Coded as VT in the BC Land Classification System.

[5] Ownership code C refers to land available for long-term integrated resource management. Ownership 62 is crown forest management unit (TSA) or crown timber agreement lands. Ownership 69 is crown miscellaneous reserves.

5.3 Data Source

The inventory data was from the original FIP files used for sample selection, projected to year of field work[6].

The inventory file (which used mapsheet and polygon numbers as keys) was linked to the compiled data file (which used cluster identification as key) through a file that provided the complete sample selection list and the corresponding VRI sample number (cluster id), mapsheet, and polygon for each sample[7].

As changes and corrections to the sample data were made, the data was recompiled (see section 5.4 for examples). The final compiled data used in the analysis was provided on December 2, 1999[8]. One additional compilation, that provided data compiled to a special utilization, was provided on December 21, 1999.

5.4 Data issues related to the analysis

Ground data was collected for a total of 109 samples that were vegetated, treed and in ownership 62C or 69C. Ground attributes for these 109 samples were compiled using the Ministry of Forests, RIB, VRI compiler. Sample #4 was dropped from the analysis because it was installed in the wrong polygon. Samples #46 and #83 fell in polygons that had been logged and hence no longer met the population criteria of being vegetated and treed. They were not included in the analysis.

After these removals, a total of 106 samples remained in the analysis population.

There were several samples for which no height or age data were available due to a lack of trees. In general, where the sample fell in a "hole" or untreed portion of a polygon, the ground values for height and age were recorded as "missing". However, the zero values for compiled volumes for such samples were considered as valid zeros in the analysis.

A log of data issues encountered and their treatment in this analysis is documented in Appendix A-3.

5.5 Weighting

The original population is often pre-stratified before sample selection to achieve efficiency or to improve estimation precision. In the Dawson Creek TSA, the stakeholders identified a particular interest in the At/Ac strata hence a slightly higher proportion of samples were selected in these types, relative to the area they represented in

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[6] The inventory data was provided by Gary Johansen on October 27, 1999 in a file called 300_fin.dbf. A file called bob-gary.xls (also dated October 27, 1999) accompanied the inventory data and was used to cross-reference mapsheet and polygon numbers with VRI sample numbers.

[7] This file was provided by Gary Johansen on October 27, 1999 and was called "bob-gary.xls".

[8] The compiled ground data was provided by Alf Kivari on December 2, 1999 in files called "Dawson cluster summary de299.xls" and "Dawson cluster x spp summary de299.xls". The compilation that included the special utilization was provided on December 21, 1999 in the files "Dawson cluster summary de2199 special.xls" and "Dawson cluster x spp summary de2199 special.xls".

the TSA. To account for the different sample selection probabilities in the At/Ac versus non-At/Ac strata, the samples required weights.

Note that when the data was post-stratified for analysis, all of the At/Ac samples comprised a single stratum. Within a stratum, all samples had the same weight and hence weights were not required for the computation of strata statistics.

However, whenever the data from the At/Ac samples are combined with data from non-At/Ac samples (e.g. in the computation of overall statistics), sampling weights must be used. The weights reported in Table 1 are for the population of VT polygons in the Dawson Creek forest district in ownership 62C or 69C[9].

Table 1: Areas and weights for strata within population of interest (VT, 62C or 69C, type id 6 included).

Stratum	Population		Sample			
	Area (ha)	%	# of clusters [10] = n	%	Weight = area/n	Relative weight
Ac/At leading	377,087	26%	36	34%	10,475	1
Non-Ac/At leading	1,080,770	74%	70	66%	15,440	1.474
total	1,457,856		106			

5.6 Post-stratification

The sample data used in the Dawson Creek VRI analysis was post-stratified in an effort to provide more precise adjustment for specific forest types within the population of interest.

The strata were determined based on a number of criteria including:

- Similar relationships in the ratios between the ground attribute values and the inventory values;
- Natural biological groupings;
- TSR analysis units;
- Number of samples available.

[9] If the population of interest is changed, the areas and sample sizes, and hence weights, will also change. Appendix A-2 provides the appropriate weights for a population of interest that excludes non-productive (type id =6) forest types.

[10] In this document, clusters are usually referred to as "samples".

Using these criteria, the project team identified 5 strata, defined primarily on the leading species indicated by the inventory. The composition of these strata and the number of samples that comprised each of them is shown in Table 2 below.

Table 2: Dawson Creek VRI strata and sample distribution among strata.

Strata composition (based on inventory attributes)	*Number of samples*
Lodgepole pine leading polygons (excluding those that indicate stocking class 4)	27
Balsam leading polygons	10
Aspen or poplar leading polygons	36
White spruce leading polygons	19
Black spruce, tamarack (larch) or stocking class 4 lodgepole pine polygons	14
Total	106

Note that the stratification above does not cover inventory polygons leading in species such as birch. ***Before adjustments are made, the district must determine the most appropriate strata for polygons leading in species not covered by the stratification above.***

5.7 Attributes to be adjusted

5.7.1 Age and height

Adjustments for inventory age and inventory height were developed in each stratum. The adjustments used the ratio-of-means approach. The ratio for age was calculated as:

$$\text{Ratio} = \frac{\textit{mean ground age}}{\textit{mean inventory age}}$$

where mean ground age is the mean VRI Phase II age for the samples in a stratum and mean inventory age is the mean projected map label age for the samples in a stratum[11]. The ratio for height was calculated in a similar manner.

A number of different ages and heights were available in the compilation of the ground data. After considerable discussion and consultation[12], the following definition for ground age and height was developed:

[11] The ratio is more precisely defined as the ratio of ***weighted*** means. In this analysis of the Dawson Creek VRI data, all samples in each stratum had the same weight hence the ratio of means and the ratio of weighted means provided the same result.

> Ground height is average height of T,L,S trees for the leading species at 17.5 cm+ utilization (from the "species within cluster" summary compilation file). If the total basal area/ha (from cluster summary compilation file) at the 17.5 cm+ utilization did not represented at least 50% of the total basal area/ha at 4cm + dbh, the utilization was relaxed (lowered) until the total basal area/ha met this criterion. If average height was not available for the leading species at this utilization, average height for the second species at this utilization was used, so long as the leading and second species were either both coniferous or both deciduous. If average height was not available for either the leading or second species, the utilization was relaxed and the leading species was reassessed. Ground age was determined in the same manner.

There were a small number of samples for which this rule provided ambiguous results. In these cases, the project team made recommendations for appropriate ground heights and /or ages on a case-by-case basis. The details of these special cases are provided in the log of data issues in Appendix A-3.

5.7.2 Volume

The adjustment for volume was developed using the same two-step process defined in the Fraser Protocol. First, the inventory age and height were adjusted for each sample polygon. These adjusted attribute values were then used as input for VDYP[13] to predict an "attribute-adjusted" inventory volume. Next, ratio-of-means adjustment factors were computed in each stratum based on a ratio of the mean compiled ground volume to the mean "attribute-adjusted" inventory volume for the samples in a stratum.

All ground and the inventory volumes reported in this analysis were net decay, waste and breakage. Standard Ministry of Forests taper functions and loss factors were used in the compilation. The ground volumes reported here were for live trees only.

Adjustment factors were developed for several alternative diameter utilizations (refer to the table of volume adjustment factors). All inventory volumes were for either 17.5 or 12.5 cm+ dbh utilization. Ground volumes were either for 17.5, 12.5 or a special[14] 9.0 cm+ dbh utilization. ***Note that the Dawson Creek district and regional staff, in consultation with the timber supply analyst, must decide on the most appropriate set of ratios (i.e. utilization levels) to use.***

5.8 Adjustment methodology

The ratio-of-means estimator was used as the methodology for adjusting the inventory attribute values. This is consistent with the approach used to adjust the inventory for TSR

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[12] The definition for ground age and height for adjustment purposes was developed in a series of meetings in the early fall of 1999, by RIB staff and consultants.

[13] VDYP version 6.4a was used in this analysis.

[14] The 9.0 cm+ dbh utilization was used to approximate a special utilization prescribed in the Dawson Creek district based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, this diameter limit applied to all species within the cluster.

purposes in the Fraser TSA and the Queen Charlotte Islands TSA. The ratio-of-means methodology has also been used in other VRI analysis projects[15].

In general, the adjustment methodology should be unbiased and easy to apply in the TSR analysis context. Adjustment methodologies that produce non-zero intercepts must be viewed with caution since negative attribute values or (in the case of a positive intercept) minimum non-zero attribute values could have serious implications in a timber supply context.

5.9 Limitations of the adjustment methodology

Ratio-of-means is generally appropriate if the relationship between y (ground attribute, in this case) and x (inventory attribute) is linear and passes through the origin. In some strata, this was not the case and a pattern of bias was observed in the residuals (see section 7.2.3).

Alternative regression methodologies such as least squares regression and geometric mean regression typically have non-zero intercept values unless they are conditioned to go through the origin. In cases where the y:x relationships do not appear to go through the origin, the regression methodologies often result in either a very shallow slope (for positive intercept values) or a very steep slope (for negative intercept values). Such functions may lead to large adjustment errors when applied to polygons outside of the range of the sample data.

Non-linear regression adjustment methodologies that go through the origin can be readily fit to the sample data. Although potential problems with non-zero intercepts can be avoided with these methodologies, the non-linear regression functions typically still face the same prediction issues for polygons beyond the highest range of the sample data as do other linear least squares regression methodologies.

Further study of the implications of alternative adjustment methodologies is required.

5.10 Ecological and other timber attributes for which summary statistics will be generated

Resources Inventory Branch is currently developing methodology to summarize and report on the ecological data that was collected. See Appendix A-5 for a list of reports that are currently available which summarize ecological and other timber attributes.

[15] Draft analyses based using ratio-of-means as the adjustment model have been prepared for the Sunshine Coast, Lillooet and Williams Lake districts.

6 Discussion of results

6.1 Descriptive sample statistics (before adjustment)

Scatter plots showing the relationships between ground attributes and inventory attributes (age and height) are provided in Appendix A-6. The relationships between ground volume and "attribute-adjusted" volume are shown in Appendix A-7.

Mean values and confidence intervals for ground attributes and unadjusted inventory attributes are shown in Tables 3 and 4.

Table 3: Descriptive statistics for ***ground*** sample attributes, by strata.

Strata	Mean *ground* attributes and 95% confidence intervals				
	n	Height (m)	Age (yrs)	Volume/ha 12.5cm+dbh, net dwb	Volume/ha 17.5cm+dbh, net dwb
Lodgepole pine (except StkCls 4)	27	16.3 14.5 – 18.1	98 81 – 114	161 120 – 201	133 93 – 173
Balsam	10	13.6 9.6 – 17.5	134 84 – 184	98 29 – 167	84 19 – 149
White Spruce	19	20.8 (n=17) 17.0 – 24.5	123 (n=18) 100 – 146	204 145 – 263	194 133 – 256
Black Spruce, Lt, StkCls 4 Pl	14	13.0 11.2 – 14.8	100 78 – 123	110 40 – 180	79 22 – 135
All coniferous	70	16.3 14.9 – 17.8	110 98 – 122	153 126 – 181	132 105 – 159
Aspen/Poplar	36	20.1 18.4 – 21.9	77 70 – 85	173 125 – 220	161 114 – 209

Table 4: Descriptive statistics for ***unadjusted inventory*** sample attributes, by strata.

Strata	Mean *unadjusted inventory* attributes and 95% confidence intervals				
	n	Height (m)	Age (yrs)	Volume/ha 12.5cm+dbh, net dwb	Volume/ha 17.5cm+dbh, net dwb
Lodgepole pine (except StkCls 4)	27	17.3 15.2 – 19.3	103 87 – 119	163 127 – 199	135 98 – 172
Balsam	10	12.8 7.0 – 18.6	137 80 – 194	98 34 – 162	84 21 – 148
White Spruce	19	21.9 18.5 – 25.4	155 127 – 183	206 148 – 264	193 134 – 252
Black Spruce, Lt, StkCls 4 Pl	14	13.8 12.4 – 15.3	101 91 – 111	73 49 – 96	46 68 – 25
All coniferous	70	17.2 15.6 – 18.8	122 109 – 134	147 122 – 172	126 101 – 151
Aspen/Poplar	36	20.4 18.4 – 22.4	84 75 – 94	130 103 – 158	121 92 – 150

6.2 Adjustment coefficients and associated statistics

6.2.1 Height and age adjustment

Ratio-of-means adjustment factors were developed for inventory height and age in each stratum. These are shown in Tables 5 and 6 that follow. Correlation coefficients are also provided in these tables as a measure of the strength of the linear relationship between the audit and the inventory heights or ages.

With the exception of balsam leading stands, inventory height for the samples was generally overestimated when compared with the ground heights. However, this overestimation was not more than about 6% in any of the strata. For balsam leading stands, the VRI sample indicated that heights were underestimated by about 6%.

The analysis indicated that ages are typically overestimated in the inventory. The magnitude of overestimation ranges from 1% (in the Black Spruce, Tamarack, StkCls 4 Pl stratum) to about 18% (in the white spruce stratum).

Table 5: Height adjustment factors (ratio of means), by strata.

Strata[16]	*n*	Height adjustment: Ratio-of-means			
		Mean ground height	Mean inventory ht	Correlation	Ratio-of-means Adjustment factor
Lodgepole pine (except StkCls 4)	27	16.3	17.3	0.567	0.943
Balsam	10	13.6	12.8	0.877	1.061
Aspen/Poplar	35	20.1	20.6	0.709	0.980
White Spruce	17	20.8	22.2	0.489	0.937
Black Spruce, Tamarack, StkCls 4 Pl	14	13.0	13.8	0.264	0.941

Table 6: Age adjustment factors (ratio of means), by strata.

Strata	*n*	Age adjustment: Ratio-of-means			
		Mean ground age	Mean inventory age	Correlation	Ratio-of-means Adjustment factor
Lodgepole pine (except StkCls 4)	27	98	103	0.742	0.947
Balsam	10	134	137	0.837	0.979
Aspen/Poplar	35	77	86	0.592	0.905
White Spruce	18	123	151	0.522	0.815
Black Spruce, Tamarack, StkCls 4 Pl	14	100	101	0.181	0.990

6.2.2 Volume adjustment

The adjustment factors for volume were derived for each stratum in a two-step process:

1. The adjustment factors in Tables 5 and 6 respectively were applied to the inventory heights and ages for the samples. Using these adjusted attribute values, inventory volumes for the samples were generated in VDYP. The volumes produced in this step are referred to as "attribute-adjusted" inventory volumes.
2. Adjustment factors for volume – ratios between the ground volume and the "attribute-adjusted" volume – were then calculated.

[16] The strata are determined from the leading species indicated by the inventory (i.e. map label).

There are two important issues to note when applying the volume adjustment factors to the inventory file:

1. The volume adjustment factors must be applied to the "attribute-adjusted" inventory volumes, that is, the VDYP volumes obtained based on adjusted heights and ages.
2. The resulting adjusted inventory volumes will reflect the utilization for the ground volumes used to derive the volume adjustment factor.

The volume adjustment factors (ratio-of-means) that were developed are provided in Table 7.

Note that for each of the proposed height, age and volume adjustments, the adjusted values of the attribute were compared with the ground values in each stratum. The difference between the ground value and the adjusted value is called a residual value and can be used in the statistical evaluation of the adjustment. A complete analysis of the residual values associated with the age, height and volume adjustments was completed and the results of this analysis are provided in Appendices A-8 and A-9.

Table 7: Volume adjustment factors (ratio of means), by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization17 is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume adjustment: Ratio-of-means					
		Mean ground vol/ha	Compiler Util'n[18]	Mean "attrib-adjd" inventory vol/ha	Inventory Util'n	Correl'n	Ratio-of-means Volume Adjustment factor
Lodgepole pine (except StkCls 4)	27	161	12.5cm+	144	12.5cm+	0.597	1.115
Lodgepole pine (except StkCls 4)	27	186	9.0cm+	144	12.5cm+	0.580	1.288
Balsam (17.5cm+)	10	84	17.5cm+	93	17.5cm+	0.918	0.902
Aspen/Poplar (12.5cm+)	36	173	12.5cm+	121	12.5cm+	0.653	1.426
White Spruce (17.5cm+)	19	194	17.5cm+	171	17.5cm+	0.596	1.137
Black Spruce (17.5cm+), Tamarack (17.5cm+), StkCls 4 Pl (12.5cm+)	14	99	Sb/L[19]: 17.5cm+; Pl: 12.5cm+	53	Sb/L: 17.5cm+; Pl: 12.5cm+	0.288	1.844
Black Spruce (9.0cm+), Tamarack (9.0cm+), StkCls 4 Pl (9.0cm+)	14	137	Sb/L: 9.0cm+; Pl: 9.0cm+	62	Sb/L: 12.5cm+; Pl: 12.5cm+	0.183	2.204
Black Spruce (17.5cm+), Lt (17.5cm+), StkCls4 Pl (9.0cm+)	14	110	Sb/L: 17.5cm+; Pl: 9.0cm+	53	Sb/L: 17.5cm+; Pl: 12.5cm+	0.307	2.062

6.3 Evaluation of the results based on target sampling errors

The original ground sampling plan specified a target sampling error of 10% for the vegetated, treed portion of the district (including TFL 48, private land, parks and reserves). At this time, completion of District-wide sampling according to the original ground sampling plan is on hold.

The district had the expectation of achieving sampling errors of 15% (at a 95% probability level) in each of the two main strata of interest: Ac/At leading; and non-Ac/At leading. The target sampling error, overall, was set at 10% (at a 95% probability level).

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[17] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

[18] Adjusted volumes will reflect the utilization for the ground samples (i.e. the compiler utilization indicated in this column).

[19] Where utilization is mixed within a strata, the utilization for the sample is determined based on the leading species indicated by the inventory (map label).

To provide an indication of the sampling error achieved in the adjustment process, a comparison of the mean ground volumes and the mean unadjusted inventory volumes were made. Overall, the sampling error for the Dawson Creek TSA was about 12%. For the two main strata of interest, the ratio of mean volumes and the sampling error for these ratios are shown in Table 8. Note that these sampling errors correspond to a population of interest that included non-productive (type id 6) types.

Table 8: Comparison of ground volumes and unadjusted inventory volumes, by main strata of interest.

Strata	Mean volumes/ha, ratios and 95% confidence interval for ratios					
	n	Ground volume/ha (net dwb)	Unadjusted inventory volume/ha (net dwb)	Ratio of means	95% CI for ratio	Sampling error (as % of ratio)
All coniferous strata (17.5cm+ dbh for Sw and B; 12.5cm+ for all other strata)	70	149	142	1.05	0.88 – 1.21	15.7%
Lodgepole pine (except StkCls 4)	27	161	163	0.99	0.78 – 1.20	21.3%
Balsam	10	84	84	1.00	0.69 – 1.30	30.6%
White Spruce	19	194	193	1.00	0.73 – 1.28	27.3%
Black Spruce, Tamarack, Pl StkCls 4	14	110	73	1.51	0.53 – 2.50	65.1%
Aspen/Poplar (12.5cm+ dbh)	36	173	130	1.33	1.05 – 1.61	21.1%

The sampling errors achieved were above the target levels that the district expected to achieve. Appendix A-11 provides further information on the relationship between sample size, sampling error, and probability level for the two main strata of interest. The stakeholders need to review these sampling error results in consideration of their current business needs and decide if additional sampling is required.

7 Application of results for TSR

The stakeholders have yet to determine how these results will be incorporated into the TSR process. If these results are used to adjust the base-case TSR planning file, a series of evaluations would be required to ensure that the adjustments developed from the sample produced similar results when applied to the population as a whole. Detailed criteria for evaluating the adjustment are still being developed, but are likely to include a series of comparisons of totals and averages by strata. It is recommended that the results of the TSR adjustment evaluation be appended to this report.

8 Appendices

A-1 Dawson Creek TSA Inventory Audit Results

Please refer to the following Web address for a published version of the Dawson Creek TSA Inventory Audit Report.

http://www.for.gov.bc.ca/resinv/audits/dawstsa.htm

A-2 Sample List

VRI Plot Number	Replaced Sample Number	Plot Type	Land Cover Type	Group	**Correct Map # - changes in bold**	**Original Map #**	POLY_NO_A	New Polygon Number	NPROD_DESC	NPROD_CD	SPCS_1	TYPID_PROJ	AGECL_PROJ	HTCL_PROJ	CRCL_CLASS	BCLCS_CODE	Sample Resp.	Original 60	VT in Ownerships 62C or 69C	VT in 62C, 69C, leading AT or AC	VRI Sample Expected in 1999	Sample Type Expected in 1999	**VT/62C/69C Sub Unit NVAF**	**VT/62C/69C NVAF Decid**
1		F	VT	A	093i039	093i039	0440		NP	12	SW	6	8	2	1	VTUTCSP	M		x		Y	F		
2		F	VT	A	093i070	093i070	0861			0	PL	2	6	2	5	VTUTCOP	M	x	x		Y	F		
3		F	VT	A	093i076	093i076	0274			0	PL	2	5	3	6	VTUTCOP	M		x		Y	F		
4		F	VT	A	093i085	093i085	0329			0	PL	1	3	1	4	VTUTCOP	M	x	x		Y	F		
5		F	VT	A	093i088	093i088	0358			0	PL	2	6	2	6	VTUTCOP	M		x		Y	F		
6		F	VT	A	093i096	093i096	0218		AF	10	BL	6	6	1	3	VTUTCOP	M	x	x		Y	E		
7		F	VT	A	093o078	093o078	0050			0	BL	2	8	2	3	VTUTCOP	M		x		Y	F		
8		F	VT	A	093o089	093o089	0369			0	BL	2	8	3	4	VTUTCOP	M	x	x		Y	E		
9		F	VT	A	093p006	093p006	0013	1519		0	PL	2	7	3	5	VTUTCOP	M		x		Y	F		
10		F	VT	A	093p007	093p007	0041			0	PL	2	7	2	7	VTUTCDE	M	x	x		Y	E		
11		F	VT	A	093p009	093p009	0033			0	PL	2	6	2	7	VTUTCDE	M		x		Y	F		
12		F	VT	A	093p023	093p023	0221			0	PL	2	8	2	5	VTUTCOP	M	x	x		Y	E		
13		F	VT	A	093p026	093p026	0614			0	PL	1	1	1	1	VTUTCSP	M		x		Y	F		
14		F	VT	A	093p036	093p036	0202			0	AT	2	5	3	6	VTUTBOP	M	x	x	x	Y	E		
15		F	VT	A	093p062	093p062	0042			0	PL	2	6	3	4	VTUTCOP	M		x		Y	F		
16		F	VT	A	094a015	094a015	0306			0	AT	2	6	3	5	VTUTBOP	M	x	x	x	Y	E		
17		F	VT	A	094a017	094a017	0305			0	SW	2	7	3	5	VTUTCOP	M							
18		F	VT	a	**093o050**	093o099	0490	133		0	PL	2	6	4	0	VT	M	x			Y	F		
19		F	VT	a	093p041	093p041	0388			0	PL	2	5	2	0	VT	T							
20		F	VT	a	**093p052**	093p041	0038			0	PL	2	6	3	0	VT	M	x			Y	F		
21		F	VT	a	**093o049**	093p052	0197			0	S	2	8	2	0	VT	T							
22		F	VT	a	**093o030**	093i089	0060			0	S	2	8	3	0	VT	M	x			Y	F		
23		F	VT	a	**093p042**	094a003	0272			0	AT	2	7	3	0	VT	T							
24		F	VT	a	**093p034**	093p018	0317	615		0	AT	2	5	3	0	VT	M	x			Y	F		
25		F	VN	A	093i086	093i086	0338			0		5	0	0	7	VNU****	M							
26		F	VN	A	093i094	093i094	0307			0		5	0	0	6	VNU****	M	x			Y	E		
27		F	VN	A	093o069	093o069	0476			0		4	0	0	0	VNUSL**	M							

VRI Plot Number	Replaced Sample Number	Plot Type	Land Cover Type	Group	**Correct Map # - changes in bold**	**Original Map #**	POLY_NO_A	New Polygon Number	NPROD_DESC	NPROD_CD	SPCS_1	TYPID_PROJ	AGECL_PROJ	HTCL_PROJ	CRCL_CLASS	BCLCS_CODE	Sample Resp.	Original 60	VT in Ownerships 62C or 69C	VT in 62C, 69C, leading AT or AC	VRI Sample Expected in 1999	Sample Type Expected in 1999	**VT/62C/69C Sub Unit NVAF**	**VT/62C/69C NVAF Decld**
28		F	VN	A	093p004	093p004	0283			0		4	0	0	0	VNUSL**	M	x			Y	E		
29		T	VT	A	093i088	093i088	0850			0	PL	1	3	1	3	VTUTCOP	M		x		Y	T		
30		T	VT	A	093o098	093o098	0156			0	PL	2	7	3	4	VTUTMOP	M	x			N			
31		T	VT	A	093p011	093p011	0121		AF	10	BL	6	4	2	1	VTUTCSP	M		x		Y	T		
32		T	VT	A	093p020	093p020	0409			0	AT	1	4	3	4	VTUTBOP	M	x	x	x	N			
33		T	VT	A	093p030	093p030	0171			0	PL	1	4	2	2	VTUTCSP	M		x		Y	T		
34		T	VT	A	093p039	093p039	0386			0	SB	1	6	2	4	VTWTCOP	M	x	x		N			
35		T	VT	A	093p040	093p040	0450			0	AT	2	5	3	4	VTUTBOP	M		x	x	Y	T		
36		T	VT	A	093p091	093p091	0204		NP	12	LT	6	4	2	4	VTUTCOP	M	x	x		N			
37		T	VT	a	093o039	093o039	0663		AF	10	B	6	8	2	0	VT	T							
38		T	VT	a	093o037	093o037	0066		AF	10	B	6	8	2	0	VT	M	x	x		N			
39		T	VT	a	093p031	093p031	0220			0	PL	2	5	3	0	VT	T							
40		T	VT	a	093p052	093p052	0557			0	PL	2	7	3	0	VT	M	x			N			
41		F	VT	B	093i069	093i069	0033			0	SW	2	8	2	6	VTUTCOP	M	x	x		Y	F		
42		F	VT	B	093i070	093i070	0029			0	SW	1	3	1	6	VTUTCOP	M	x	x		Y	F		
43		F	VT	B	093i092	093i092	0381			0	SW	2	8	3	3	VTUTCOP	M	x	x		Y	E		
44		F	VT	B	093i100	093i100	0853			0	SB	1	5	1	6	VTWTCOP	M	x	x		Y	E		
45		F	VT	B	093o046	093o046	0252			0	BL	2	8	2	3	VTUTCOP	M	x	x		Y	E		
46		F	VT	B	093o069	093o069	0085			0	SW	2	8	3	5	VTUTCOP	M	x	x		Y	E		
47		F	VT	B	093o088	093o088	0131			0	SW	2	8	4	3	VTUTCOP	M	x			Y	E		
48		F	VT	B	093p030	093p030	0457			0	AT	1	3	2	3	VTUTBOP	M	x	x	x	Y	E		
49		F	VT	B	094a003	094a003	0124			0	AT	2	5	3	6	VTUTBOP	M	x	x	x	Y	E		
50		F	VT	b	**093p031**	094a005	0040			0	PL	1	2	1	0	VT	M	x			Y	F		
51		F	VT	b	**093p021**	093i055	0160			0	S	2	8	2	0	VT	M	x			Y	F		
52		F	VT	b	093p015	093p015	0668			0	PL	2	5	2	0	VT	M	x			Y	E		
53		F	VT	b	**093o050**	093p030	0091			0	S	2	8	2	0	VT	M	x			Y	F		
54		F	VT	b	**093p011**	093p008	0353			0	S	1	4	3	0	VT	M	x			Y	F		
55		F	NL	B	093p036	093p036	0163		CL	9		6	0	0	0	NLUELES	M	x			Y	F		

VRI Plot Number	Replaced Sample Number	Plot Type	Land Cover Type	Group	**Correct Map # - changes in bold**	**Original Map #**	POLY_NO_A	New Polygon Number	NPROD_DESC	NPROD_CD	SPCS_1	TYPID_PROJ	AGECL_PROJ	HTCL_PROJ	CRCL_CLASS	BCLCS_CODE	Sample Resp.	Original 60	VT in Ownerships 62C or 69C	VT in 62C, 69C, leading AT or AC	VRI Sample Expected in 1999	Sample Type Expected in 1999	**VT/62C/69C Sub Unit NVAF**	**VT/62C/69C NVAF Decid**
56		F	VN	B	093o030	093o030	1502			0		4	0	0	0	VNUSL**	M	x			Y	E		
57		F	VN	B	093p054	093p054	0239			0		4	0	0	0	VNUSL**	M	x			Y	E		
58		T	VT	B	093i039	093i039	0035			0	PL	1	4	2	4	VTUTCOP	M	x	x		Y	T		
59		T	VT	B	093i040	093i040	0135			0	PL	2	6	2	5	VTUTCOP	M	x	x		Y	T		
60		T	VT	B	093i070	093i070	0539			0	PL	2	6	2	7	VTUTCDE	M	x	x		Y	T		
61		T	VT	B	093o057	093o057	0266			0	BL	1	1	1	1	VTUTCSP	M	x	x		N			
62		T	VT	B	093o077	093o077	0226			0	SW	2	9	2	3	VTUTCOP	M	x			N			
63		T	VT	B	093o080	093o080	0244			0	PL	2	6	2	4	VTUTCOP	M	x	x		N			
64		T	VT	B	093o086	093o086	0427			0	BL	2	8	3	4	VTUTCOP	M	x			N			
65		T	VT	B	093p006	093p006	0333			0	PL	2	8	2	6	VTUTCOP	M	x	x		N			
66		T	VT	B	093p008	093p008	0312			0	PL	2	6	3	7	VTUTCDE	M	x	x		Y	T		
67		T	VT	B	093p018	093p018	0284			0	AT	2	5	2	6	VTUTBOP	M	x	x	x	N			
68		T	VT	B	093p036	093p036	0539			0	SW	1	6	3	6	VTUTMOP	M	x	x		N			
69		T	VT	B	093p038	093p038	0037			0	SB	1	6	2	6	VTWTCOP	M	x	x		Y	T		
70		T	VT	B	093p050	093p050	0304			0	AT	1	3	2	5	VTUTBOP	M	x			N			
71		T	VT	B	093p054	093p054	0451			0	AT	1	2	2	4	VTUTBOP	M	x	x	x	N			
72		T	VT	B	093p059	093p059	0297			0	AT	2	7	3	5	VTUTMOP	M	x	x	x	N			
73		T	VT	B	093p091	093p091	0692		NP	12	LT	6	4	2	4	VTUTCOP	M	x	x		N			
74		T	VT	B	094a003	094a003	0456			0	AT	2	5	2	5	VTUTBOP	M	x	x	x	N			
75		T	VT	b	093p034	093p034	0265			0	AT	2	5	3	0	VT	M	x			N			
76		T	VT	b	093p063	093p063	0385			0	S	1	6	3	0	VT	M	x	x		N			
77		T	VT	b	093p034	093p034	0084	393		0	PL	2	5	2	0	VT	M	x	x		Y	T		
78		T	VT	b	093p024	093p024	0275	381		0	PL	1	3	2	0	VT	M	x	x		N			
79		T	VT	b	093o040	093o040	0192			0	PL	1	2	1	0	VT	M	x			N			
80		T	VT	b	093o050	093o050	0101			0	S	2	8	2	0	VT	M	x			N			
81		F	VT	C	093i058	093i058	0526			0	PL	2	5	2	7	VTUTCDE	M		x		Y	F	x	
82		F	VT	C	093i098	093i098	0548			0	PL	1	3	1	6	VTUTCOP	M		x		Y	F		
83		F	VT	C	093o067	093o067	0272			0	SW	2	8	3	4	VTUTCOP	M		x		Y	F	x	

VRI Plot Number	Replaced Sample Number	Plot Type	Land Cover Type	Group	**Correct Map # - changes in bold**	**Original Map #**	POLY_NO_A	New Polygon Number	NPROD_DESC	NPROD_CD	SPCS_1	TYPID_PROJ	AGECL_PROJ	HTCL_PROJ	CRCL_CLASS	BCLCS_CODE	Sample Resp.	Original 60	VT in Ownerships 62C or 69C	VT in 62C, 69C, leading AT or AC	VRI Sample Expected in 1999	Sample Type Expected in 1999	**VT/62C/69C Sub Unit NVAF**	**VT/62C/69C NVAF Decid**
85		F	VT	C	093p039	093p039	0095			0	SB	1	5	2	3	VTWTCOP	M		x		Y	F		
86		F	VT	C	093p040	093p040	0103			0	AT	1	4	3	4	VTUTBOP	M		x	x	Y	F		x
87		F	VT	C	093p060	093p060	0122			0	AT	1	4	3	6	VTUTBOP	M		x	x	Y	F		
88		F	VT	C	093p077	093p077	0186			0	AT	1	2	1	4	VTUTBOP	M		x	x	Y	F		
89		F	VT	C	094a011	094a011	0409			0	AC	1	2	1	2	VTUTBSP	M		x	x	Y	F	x	x
90		F	VT	c	**093p062**	093i076	0327			0	AT	1	3	2	0	VT	M							
91		F	VT	c	**093p035**	093p042	0247	167		0	PL	2	5	2	0	VT	T		x		Y	F	x	
93		F	NL	C	093i074	093i074	0161		A	2		6	0	0	0	NLAROBR	M							
95		F	NL	C	093o039	093o039	0002		A	2		6	0	0	0	NLAROBR	M							
97		F	NL	C	093o086	093o086	0354		A	2		6	0	0	0	NLAROBR	T							
100		T	VT	C	093i059	093i059	0611		NP	12	PL	6	5	2	7	VTUTCDE	M		x		Y	T		
101		T	VT	C	093i067	093i067	0556			0	PL	2	5	2	7	VTUTCDE	M							
102		T	VT	C	093i069	093i069	0507			0	PL	2	6	2	7	VTUTCDE	M		x		Y	T		
103		T	VT	C	093i078	093i078	0065			0	PL	2	8	2	5	VTUTCOP	M		x		Y	T		
104		T	VT	C	093i079	093i079	0545			0	AT	2	6	2	4	VTUTMOP	M		x	x	Y	T	x	x
105		T	VT	C	093i080	093i080	0440			0	PL	2	7	3	6	VTUTCOP	M		x		Y	T		
106		T	VT	C	093i089	093i089	0639			0	SW	2	8	2	3	VTUTMOP	M		x		Y	T		
107		T	VT	C	093o069	093o069	0412			0	PL	2	6	3	5	VTUTCOP	M		x		Y	T		
108		T	VT	C	093o097	093o097	0139			0	PL	2	7	3	3	VTUTCOP	M							
109		T	VT	C	093p026	093p026	0314			0	SW	1	6	4	5	VTUTCOP	M		x		Y	T		
110		T	VT	C	093p027	093p027	0300			0	PL	2	8	3	5	VTUTCOP	M		x		Y	T	x	
111		T	VT	C	093p033	093p033	0094			0	PL	1	3	2	4	VTUTCOP	M		x		Y	T	x	
113		T	VT	C	093p061	093p061	0105			0	SW	2	7	3	4	VTUTCOP	M		x		Y	T		
115		T	VT	c	093p005	093p005	0395			0	PL	2	6	2	0	VT	M							
116		T	VT	c	093p035	093p035	0175	385		0	S	2	7	3	0	VT	M		x		Y	T		
117		T	VT	c	093o040	093o040	0243			0	S	2	9	2	0	VT	M							
118		T	VT	c	093p005	093p005	0537			0	S	1	5	2	0	VT	T							
119		T	VT	c	093p051	093p051	0400			0	S	2	7	2	0	VT	M							

VRI Plot Number	Replaced Sample Number	Plot Type	Land Cover Type	Group	**Correct Map # - changes in bold**	**Original Map #**	POLY_NO_A	New Polygon Number	NPROD_DESC	NPROD_CD	SPCS_1	TYPID_PROJ	AGECL_PROJ	HTCL_PROJ	CRCL_CLASS	BCLCS_CODE	Sample Resp.	Original 60	VT in Ownerships 62C or 69C	VT in 62C, 69C, leading AT or AC	VRI Sample Expected in 1999	Sample Type Expected in 1999	**VT/62C/69C Sub Unit NVAF**	**VT/62C/69C NVAF Decid**
120		T	VT	c	093p015	093p015	0319	1632		0	PL	2	6	2	0	VT	T		x		Y	T		
301	84	F	VT	C	094b008		0180			0	SW	2	8	3	3	VTUTCOP	T							
302	112	T	VT	C	094b027		0206			0	SW	2	7	3	4	VTUTCOP	T							
303	114	T	VT	C	094b007		0283			0	SW	2	8	3	4	VTUTCOP	T							
312	94	F	VN	C	093p078		0086		C	42		6	0	0	0	VNUHE**	M							
313	98	F	VN	C	094a010		0200		C	42		6	0	0	0	VNUHE**	M							
314	99	F	NW	C	094b017		0209		L	15		6	0	0	0	NWW**LA	M							
315	96	F	VN	C	093p089		0081		C	42		6	0	0	0	VNUHE**	M							
316	92	F	VN	C	093p080		0131		C	42		6	0	0	0	VNUHE**	M							
122		F	VT	D	093i040	093i040	0459			0	PL	2	5	2	7	VTUTCDE	M		x		Y	F		
123		F	VT	D	093i047	093i047	0611			0	BL	1	4	1	5	VTUTCOP	M		x		Y	F	x	
124		F	VT	D	093i049	093i049	0446			0	SW	1	4	1	5	VTUTCOP	M		x		Y	F	x	
125		F	VT	D	093i089	093i089	0240			0	SW	2	8	3	4	VTUTCOP	M		x		Y	F		
126		F	VT	D	093i097	093i097	0701			0	SW	2	8	3	4	VTUTCOP	M		x		Y	F	x	
127		F	VT	D	093o048	093o048	0085			0	BL	1	3	2	1	VTUTCSP	M		x		Y	F		
128		F	VT	D	093o080	093o080	0560			0	PL	2	7	3	5	VTUTCOP	M		x		Y	F		
129		F	VT	D	093o100	093o100	0294			0	AT	1	3	2	7	VTUTBDE	M		x	x	Y	F		X
130		F	VT	D	093p002	093p002	0015			0	SW	2	9	3	4	VTUTCOP	M		x		Y	F	x	
131		F	VT	D	093p018	093p018	0003			0	SB	1	4	1	6	VTWTCOP	M		x		Y	F	x	
132		F	VT	D	093p044	093p044	0133		AF	10	SW	6	5	2	3	VTUTCOP	M		x		Y	F		
133		F	VT	D	093p056	093p056	0374			0	PL	1	3	2	5	VTUTCOP	M		x		Y	F	x	
135		F	VT	D	093p073	093p073	0243			0	AT	2	8	3	5	VTUTMOP	M		x	x	Y	F		X
136		F	VT	D	093p092	093p092	0329			0	SW	1	6	3	4	VTUTCOP	M							
137		F	VT	d	**093o040**	093p005	0082			0	S	2	7	2	0	VT	M							
138		F	VT	d	**093p032**	093p062	0374			0	AT	1	3	3	0	VT	M							
139		F	VT	d	**093p025**	093p034	0096	412		0	SB	1	5	2	0	VT	T		x		Y	F	x	
140		F	NL	D	093i028	093i028	0274		A	2		6	0	0	0	NLAROBR	T							
144		F	VN	D	093p019	093p019	0088		NPBR	11		6	0	0	0	VN*ST**	T							

VRI Plot Number	Replaced Sample Number	Plot Type	Land Cover Type	Group	Correct Map # - changes in bold	Original Map #	POLY_NO_A	New Polygon Number	NPROD_DESC	NPROD_CD	SPCS_1	TYPID_PROJ	AGECL_PROJ	HTCL_PROJ	CRCL_CLASS	BCLCS_CODE	Sample Resp.	Original 60	VT in Ownerships 62C or 69C	VT in 62C, 69C, leading AT or AC	VRI Sample Expected in 1999	Sample Type Expected in 1999	VT/62C/69C Sub Unit NVAF	VT/62C/69C NVAF Decid
145		F	VN	D	093p056	093p056	0360		NPBR	11		6	0	0	0	VN*ST**	M							
147		T	VT	D	093i029	093i029	0640			0	SW	2	7	2	5	VTUTCOP	M		x		Y	T		
148		T	VT	D	093i050	093i050	0036			0	PL	2	6	2	7	VTUTCDE	M		x		Y	T	x	
149		T	VT	D	093i074	093i074	0085			0	BL	2	8	3	4	VTUTCOP	M		x		Y	T		
150		T	VT	D	093i086	093i086	0074		AF	10	BL	6	4	1	1	VTUTCSP	M		x		Y	T		
151		T	VT	D	093i094	093i094	0079			0	S	2	9	3	5	VTUTCOP	M							
152		T	VT	D	093o090	093o090	0291			0	AC	1	4	2	2	VTUTBSP	M							
153		T	VT	D	093p014	093p014	0089			0	SW	2	8	3	5	VTUTCOP	T		x		Y	T		
154		T	VT	D	093p072	093p072	0409			0	AT	2	6	4	4	VTUTBOP	T		x	x	Y	T		
155		T	VT	D	093p098	093p098	0300			0	AT	2	6	1	4	VTUTBOP	M							
156		T	VT	D	094a014	094a014	0095			0	SW	2	7	3	4	VTUTCOP	M		x		Y	T		
157		T	VT	d	093p022	093p022	0348			0	PL	2	5	2	0	VT	M							
158		T	VT	d	093p052	093p052	0390			0	AT	2	7	4	0	VT	M							
160		T	VT	d	093i093	093i093	0722			0	S	2	8	2	0	VT	T							
304	121	F	VT	D	094b008		0467			0	PL	2	6	3	4	VTUTCOP	T							
305	134	F	VT	D	094b018		0245			0	AT	1	2	1	4	VTUTBOP	T							
306	159	T	VT	D	094b017		0125			0	BL	1	6	3	4	VTUTCOP	T							
317	141	F	VN	D	094a007		0274		C	42		6	0	0	0	VNUHE**	M							
318	146	F	VN	D	093p092		552			0	S	1	1	1	1	VNU****	T							
319	143	F	VN	D	093p097		0075		C	42		6	0	0	0	VNUHE**	M							
320	142	F	VN	D	093p087		0184		C	42		6	0	0	0	VNUHE**	M							
161		F		E	093i078	093i078	0722			0	SW	2	8	2	5	VTUTCOP								
162		F		E	093o097	093o097	0456			0	SB	2	8	3	5	VTWTCOP								
163		F		E	093o099	093o099	0269			0	SW	2	8	3	3	VTUTCOP								
164		F		E	093p020	093p020	0124		NP	12	LT	6	7	1	1	VTUTCSP								
165		F		E	093p053	093p053	0527		AF	10	PL	6	7	1	3	VTUTCOP								
166		F	VT	E	093p065	093p065	0116			0	AT	1	4	3	6	VTUTBOP				x	Y	T		
167		F		E	093p087	093p087	0022			0	EP	1	3	2	2	VTUTBSP								

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168		F		E	093p080	093p080	0172			0	AT	1	4	3	7	VTUTMDE								
170		F		E	093i019	093i019	0263		A	2		6	0	0	0	NLAROBR								
171		F		E	093i045	093i045	0093		A	2		6	0	0	0	NLAROBR								
172		F		E	093i066	093i066	0251		A	2		6	0	0	0	NLAROBR								
173		F		E	093i092	093i092	0042		A	2		6	0	0	0	NLAROBR								
176		F		E	093o060	093o060	0202			0	SW	1	1	1	0	VNU****								
177		F		E	093p014	093p014	1502			0		4	0	0	0	VNUSL**								
178		T		E	093i057	093i057	0376			0	SW	2	9	3	5	VTUTCOP								
179		T		E	093i079	093i079	0087			0	PL	2	5	2	7	VTUTCDE								
180		T	VT	E	093i086	093i086	0419			0	AT	1	4	2	6	VTUTBOP				x	Y	T		X
181		T		E	093o020	093o020	0023			0	SW	2	9	3	3	VTUTCOP								
183		T		E	093o067	093o067	0052			0	SW	2	8	4	4	VTUTCOP								
184		T		E	093p002	093p002	0243			0	SW	2	9	3	4	VTUTCOP								
185		T		E	093p009	093p009	0369			0	SB	1	5	2	6	VTWTCOP								
186		T		E	093p010	093p010	0027		NP	12	LT	6	8	2	1	VTUTCSP								
187		T		E	093p012	093p012	0368			0	SW	2	9	4	5	VTUTCOP								
188		T		E	093p024	093p024	0008			0	PL	1	3	1	3	VTUTCOP								
189		T	VT	E	093p038	093p038	0427			0	AT	2	5	3	5	VTUTBOP				x	Y	T		X
190		T		E	093p093	093p093	0397			0	SW	2	7	4	5	VTUTMOP								
307	169	F		E	094b028		0185			0	AT	1	3	1	3	VTUTBOP								
308	182	T		E	094b009		0358			0	PL	2	7	3	3	VTUTCOP								
321	174	F		E	094a020		263			0		6	0	0	0	VNUHE**								
322	175	F		E	093p069		0576			0		4	0	0	0	VNUSL**								
191		F		F	093o058	093o058	0391			0	SW	1	4	3	7	VTUTCDE								
192		F		F	093o079	093o079	0448		AF	10	BL	6	8	1	2	VTUTCSP								
193		F		F	093p010	093p010	0278			0	SB	1	5	2	8	VTWTMDE								
194		F		F	093p085	093p085	0495			0	AT	1	2	1	5	VTUTBOP								
195		F	VT	F	094a005	094a005	0029			0	AT	2	5	3	7	VTUTBDE				x	Y	T		

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196		F	VT	F	094a009	094a009	0016			0	AT	1	3	2	7	VTUTBDE				x	Y	T		x
197		F		f	**093p043**	093i096	0524			0	PL	1	3	2	0	VT								
200		F		F	093i058	093i058	0073		NPBR	11		6	0	0	0	VN*ST**								
202		F		F	093i065	093i065	0070			0		5	0	0	6	VNU****								
203		F		F	093o058	093o058	0533			0		4	0	0	0	VNUSL**								
204		T		F	093i048	093i048	0338			0	BL	2	8	1	5	VTUTCOP								
205		T		F	093i059	093i059	0260			0	PL	1	2	1	1	VTUTCSP								
206		T		F	093i066	093i066	0271			0	SW	2	8	3	6	VTUTCOP								
207		T		F	093i075	093i075	0308			0	PL	2	5	2	6	VTUTCOP								
208		T		F	093i075	093i075	0699			0	BL	1	5	1	4	VTUTCOP								
209		T		F	093i090	093i090	0527			0	PL	2	6	2	7	VTUTCDE								
210		T		F	093i096	093i096	0773			0	PL	2	6	1	3	VTUTCOP								
211		T		F	093i097	093i097	0261			0	PL	1	4	2	6	VTUTCOP								
212		T		F	093o029	093o029	0099			0	S	2	8	3	4	VTUTCOP								
213		T		F	093o088	093o088	0428			0	SW	2	8	3	5	VTUTCOP								
214		T	VT	F	093p045	093p045	0200			0	AT	2	6	3	8	VTUTBDE				x	Y	T		
215		T		F	093p067	093p067	0397			0	SB	1	5	2	5	VTWTCOP								
216		T	VT	F	093p071	093p071	0108			0	AT	2	6	3	6	VTUTBOP				x	Y	T		x
218		T	VT	F	094a005	094a005	0555			0	AT	1	3	2	7	VTUTBDE				x	Y	T		
219		T	VT	F	094a013	094a013	0138			0	AT	1	4	2	5	VTUTMOP				x	Y	T		x
220		T		f	093p025	093p025	0043			0	PL	2	5	2	0	VT								
309	217	T	VT	F	094b019		0486			0	AT	2	6	4	2	VTUTBSP				x	Y	T		
323	198	F		F	094b029		0276		NPBR	11		6	0	0	0	VN*ST**								
324	199	F		F	093p064		0395		C	42		6	0	0	0	VNUHE**								
325	201	F		F	094a002		0480			0	AT	1	1	1	1	VNU****								
221		F	VT	G	093i077	093i077	0535			0	SW	2	7	2	6	VTUTCOP								
222		F	VT	G	093i081	093i081	0067		AF	10	BL	6	8	1	2	VTUTCSP								
223		F	VT	G	093i090	093i090	0238			0	PL	2	6	3	4	VTUTMOP								
224		F	VT	G	093o038	093o038	0091			0	BL	2	8	2	1	VTUTCSP								

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225		F	VT	G	093o056	093o056	0238			0	BL	2	8	3	4	VTUTCOP									
226		F	VT	G	093o096	093o096	0321		AF	10	BL	6	7	2	1	VTUTCSP									
227		F	VT	G	093p016	093p016	0349			0	PL	1	1	1	1	VTUTCSP									
228		F	VT	G	093p027	093p027	0593			0	SB	1	4	1	6	VTWTCOP									
229		F	VT	G	093p029	093p029	0435			0	SB	1	6	2	6	VTWTCOP									
230		F	VT	G	093p055	093p055	0328			0	AT	2	5	2	2	VTUTBSP				x	Y	F			x
231		F	VT	G	093p070	093p070	0186			0	AT	1	4	3	7	VTUTBDE									
232		F	NL	G	093i030	093i030	0193		A	2		6	0	0	0	NLAROBR									
233		F	NL	G	093i048	093i048	0059		A	2		6	0	0	0	NLAROBR									
234		F	NL	G	093i056	093i056	0321		A	2		6	0	0	0	NLAROBR									
235		F	NL	G	093o040	093o040	0362		A	2		6	0	0	0	NLAROBR									
236		F	NL	G	093o076	093o076	0141		A	2		6	0	0	0	NLAROBR									
237		F	NL	G	093o096	093o096	0333		A	2		6	0	0	0	NLAROBR									
239		T	VT	G	093i038	093i038	0089			0	S	2	9	3	6	VTUTCOP									
240		T	VT	G	093i065	093i065	0163			0	SW	1	4	2	5	VTUTCOP									
241		T	VT	G	093i087	093i087	0842		NP	12	SB	6	3	1	5	VTUTCOP									
242		T	VT	G	093o047	093o047	0266			0	BL	1	5	3	4	VTUTCOP									
243		T	VT	G	093o058	093o058	0038			0	BL	2	8	3	4	VTUTCOP									
244		T	VT	G	093o068	093o068	0171			0	BL	2	8	3	5	VTUTCOP									
245		T	VT	G	093o087	093o087	0327			0	BL	2	7	2	2	VTUTCSP									
246		T	VT	G	093p001	093p001	0144			0	SW	2	8	3	3	VTUTCOP									
247		T	VT	G	093p028	093p028	0360			0	SW	1	6	3	6	VTUTCOP									
248		T	VT	G	093p044	093p044	0342			0	PL	2	5	2	7	VTUTCDE									
249		T	VT	G	093p065	093p065	0520			0	AC	1	2	2	2	VTUTMSP				x	Y	T			
250		T	VT	G	093p083	093p083	0314			0	AT	2	5	3	6	VTUTBOP									
251		T	VT	G	094a001	094a001	0255			0	SW	1	6	4	6	VTUTMOP									
252		T	VT	G	094a006	094a006	0515			0	SB	1	5	2	6	VTWTCOP									
253		T	VT	G	094a025	094a025	0524			0	AT	2	5	3	7	VTUTBDE				x	Y	T			x
254		T	VT	g	093i019	093i019	0187			0	S	2	8	3	0	VT									
255		T	VT	g	093p062	093p062	0452			0	PL	2	8	3	0	VT									
326	238	F	VN	G	093p099		0054		C	42		6	0	0	0	VNUHE**									
256		F	VT	H	093i056	093i056	0393			0	SW	2	8	2	6	VTUTCOP									

VRI Plot Number	Replaced Sample Number	Plot Type	Land Cover Type	Group	**Correct Map # - changes in bold**	**Original Map #**	POLY_NO_A	New Polygon Number	NPROD_DESC	NPROD_CD	SPCS_1	TYPID_PROJ	AGECL_PROJ	HTCL_PROJ	CRCL_CLASS	BCLCS_CODE	Sample Resp.	Original 60	VT in Ownerships 62C or 69C	VT in 62C, 69C, leading AT or AC	VRI Sample Expected in 1999	Sample Type Expected in 1999	**VT/62C/69C Sub Unit NVAF**	**VT/62C/69C NVAF Decid**
257		F	VT	H	093i074	093i074	0501			0	PL	1	2	1	2	VTUTCSP									
258		F	VT	H	093i080	093i080	0044			0	PL	2	6	2	7	VTUTCDE									
259		F	VT	H	093p047	093p047	0209			0	PL	2	5	2	7	VTUTMDE									
260		F	VT	H	093p094	093p094	0398			0	AT	1	2	1	3	VTUTBOP									
261		F	NL	H	093i018	093i018	0164		A	2		6	0	0	0	NLAROBR									
262		F	NL	H	093p003	093p003	0162		A	2		6	0	0	0	NLAROBR									
263		T	VT	H	093i050	093i050	0435			0	PL	2	5	1	4	VTUTCOP									
264		T	VT	H	093i100	093i100	0280		NP	12	SB	6	4	1	3	VTUTCOP									
265		T	VT	H	093o070	093o070	0273			0	SW	1	6	3	5	VTUTMOP									
266		T	VT	H	093p046	093p046	0314			0	PL	2	5	2	3	VTUTMOP									
267		T	VT	H	093p069	093p069	0265			0	AT	2	6	3	4	VTUTMOP				x	Y	T			
268		T	VT	H	093p072	093p072	0157			0	PL	2	6	3	4	VTUTCOP									
269		T	VT	H	093p078	093p078	0283			0	AT	2	5	3	4	VTUTBOP									
270		T	VT	h	093p081	093p081	0479			0	S	1	6	4	0	VT									
271		F	VT	I	093p019	093p019	0018			0	PL	2	7	3	6	VTUTCOP									
272		F	VT	I	093p037	093p037	0271			0	SW	1	3	2	6	VTUTMOP									
273		F	VT	i	**093o048**	093p043	0518			0	S	1	4	3	0	VT									
274		F	VT	i	**093i093**	093o050	0558			0	B	2	8	2	0	VT									
275		F	VT	i	**093i054**	093i065	0184			0	S	2	9	3	0	VT									
276		F	VT	i	**093p033**	093p055	0356			0	PL	2	5	2	0	VT									
277		F	NL	I	093i083	093i083	0364		A	2		6	0	0	0	NLAROBR									
279		F	NL	i	093p023	093p023	0323		A	2		6	0	0	0	NLAROBR									
280		F	VN	i	093p047	093p047	0020			0		5	0	0	7	VNU****									
282		T	VT	i	093o098	093o098	0388			0	SW	2	7	3	4	VTUTCOP									
284		T	VT	I	093p003	093p003	0103			0	SW	2	9	3	5	VTUTCOP									
285		T	VT	I	093p058	093p058	0389			0	AT	1	4	2	2	VTUTBSP									
286		T	VT	I	093p063	093p063	0156			0	AT	2	6	3	5	VTUTMOP									
287		T	VT	I	093p066	093p066	0287			0	AT	1	4	3	6	VTUTBOP				x	Y	T			x
288		T	VT	I	093p074	093p074	0170			0	AT	2	6	3	5	VTUTBOP									
289		T	VT	i	093i019	093i019	0010			0	S	2	9	3	0	VT									
290		T	VT	i	093p064	093p064	0169			0	S	1	6	3	0	VT									
310	283	T	VT	I	094b007		0005			0	AT	2	6	3	4	VTUTMOP									

VRI Plot Number	Replaced Sample Number	Plot Type	Land Cover Type	Group	**Correct Map # - changes in bold**	**Original Map #**	POLY_NO_A	New Polygon Number	NPROD_DESC	NPROD_CD	SPCS_1	TYPID_PROJ	AGECL_PROJ	HTCL_PROJ	CRCL_CLASS	BCLCS_CODE	Sample Resp.	Original 60	VT in Ownerships 62C or 69C	VT in 62C, 69C, leading AT or AC	VRI Sample Expected in 1999	Sample Type Expected in 1999	**VT/62C/69C Sub Unit NVAF**	**VT/62C/69C NVAF Decid**
327	278	F	VN	i	093p083		0143		NPBR	11		6	0	0	0	VN*ST**									
328	281	F	VN	i	093p075		0182		C	42		6	0	0	0	VNUHE**									
291		F	VT	J	093p048	093p048	0357			0	PL	1	4	2	4	VTUTMOP									
292		F	VT	J	093p088	093p088	0179			0	AT	1	2	1	5	VTUTBOP									
293		F	VT	J	094a002	094a002	0083			0	SW	1	6	4	2	VTUTCSP									
294		F	VT	j	**093p031**	093p039	0367			0	PL	2	5	3	0	VT									
295		F	VT	J	093i076	093i076	0671		AF	10	BL	6	3	1	3	VTUTCOP									
296		F	VT	J	093o056	093o056	0053			0	BL	1	2	1	2	VTUTCSP									
297		F	VT	J	093p016	093p016	0751			0	PL	1	4	2	7	VTUTCDE									
299		F	VT	J	093p085	093p085	0062			0	AT	2	5	3	3	VTUTBOP				x	Y	F			x
300		F	VT	J	094a016	094a016	0375			0	AT	1	3	2	6	VTUTBOP				x	Y	F			x
311	298	F	VT	J	094b010		0398			0	PL	2	6	3	3	VTUTCOP									
361		T	VT	?	093p048		0295			0	AT	2	5	2	4	VTUTBOP				x	Y	T			

A-3 Data Issues Log

Project: Dawson Creek

Sample #	Issue	Inv label	Grnd label	Decision	Action
1	No ba>4cm/no ht/age for T and S trees Zero tree plot in swamp Valid sample		0 ht/ 0 age	Valid sample, plot fell in swamp. Follow up with Rob on suitability of using zero ht/age data for adjustment.	Missing values for height and age.
46	No ba>4cm/no ht/age for T and S trees Area logged	S 178 yrs/ht 24/50%cc.st k1	Advanced B regen in 2.5 m plot. <1m ht	Sample is not in veg treed population. Exclude from step 1 analysis	EXCLUDE SAMPLE.
83	Keypunch error				Corrected. See Nov. 18/99 e-mail from Matt Makar.
249	No ba>4cm/no ht/age for T and S trees No trees in main or small tree plot. Sample logged or fell in valid hole.	Ct 40yrs/14m ht	No data?	Sent to Region to confirm. Dick advised to treat as plot in hole.	Missing values for height and age. Valid zero volume.
219	Leading sp decid/ no top ht/age for leading/ 2nd species is conifer No ground ht/age (At) data for leading species at 17.5	At 65yrs/ 17.7 m ht	@17.5 At50/S50 12.5 S50/AT42	Drop utilization to 12.5 and use S data	Use Spruce data: height = 20.8; age=101.4.
267	Leading sp decid/ no top ht/age for leading/ 2nd species is conifer	At40/S32/B 28	@17.5 AT44/S32/Bi2 8	Compute prorated age. Age changed suitable for T5 Naux, T10 W aux.	Use prorate data

Sample #	Issue	Inv label	Grnd label	Decision	Action
86	Ht but no age No live standing stems, IPC in slash pile.	At100%, 73yrs,20mht	At100% ht but no age due to prorated age.	Use prorated age for T4 in S aux.	Use prorate for age; height = 25.7
126	Age but no ht	S70,Pl20B10 171 yrs, 24.1 m	Ba67S33 age but no height, age 209	IPC t#3 and Eaux T#7 changed to suitable; changes made to suitable ht	Height= 22.6 Age= 208.9
130	Age but no ht	S76,B24 284yrs, 28.6 m ht	B78,S22	Changes made to suitable age	Use prorate B age; missing value for ht.
300	Ht but no age	At100 58yrs/15.3 m	At 100% 14m ht/no age	Use prorated age for T#3 south aux.	Height = 14.0; Use prorate age.
33	Age but no ht No hts as all are unsuitable due to forked tops	Pl 70S20At10 81yrs/19.6m	17.5 pl60At40 140yrs no ht	Use forked tree heights IPC #99,2EAux#3, Saux#99,Waux #2	Age = 140.4; Height = 17.4
63	No ht or age	PL58S27B15 age 105, 13.3ht	12.5 only PL100	Plot logged; therefore not part of veg treed population. Exclude from step 1 analysis.	EXCLUDE SAMPLE.
287	No ht or age for 1st or 2nd species which are both decid/ht age only available for 3rd species which is coniferous .	At80Ac2080yrs,22.4m	Ac33At28Sw22Sb17	Problems with crew calling I or codom trees/ T9 Naux , T99 Eaux changed to suitable.	Use age=79; ht=13.2

A-4 Adjustment factors and strata weights for VT polygons EXCLUDING non-forest types

Samples classed as "non-productive forest" (type id = 6) excluded

Table 1: Height adjustment ratios (ratio of means), by strata.

Strata[20]	*n*	Height adjustment: Ratio of means			
		Mean ground height	Mean inventory ht	Correlation	Ratio of means
Lodgepole pine (except StkCls 4)	27	16.3	17.3	0.567	0.943
Balsam	*7*	*14.5*	*14.9*	*0.870*	*0.978*
Aspen/Poplar	35	20.1	20.6	0.709	0.980
White Spruce	*16*	*21.6*	*22.6*	*0.434*	*0.955*
Black Spruce, Larch, StkCls 4 Pl	*11*	*13.4*	*14.1*	*0.227*	*0.952*

Table 2: Age adjustment ratios (ratio of means), by strata.

Strata	*n*	Age adjustment: Ratio of means			
		Mean ground age	Mean inventory age	Correlation	Ratio of means
Lodgepole pine (except StkCls 4)	27	98	103	0.742	0.947
Balsam	*7*	*137*	*136*	*0.795*	*1.006*
Aspen/Poplar	35	77	86	0.592	0.905
White Spruce	*17*	*124*	*154*	*0.520*	*0.804*
Black Spruce, Larch, StkCls 4 Pl	*11*	*94*	*106*	*0.296*	*0.887*

[20] The strata are determined from the leading species indicated by the inventory (i.e. map label).

Samples classed as "non-productive forest" (type id = 6) excluded

Table 3: Volume adjustment ratios (ratio of means), by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[21] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume adjustment: Ratio of means					
		Mean ground vol/ha	Compiler Util'n	Mean inventory vol/ha	Inventory Util'n	Correlation	Ratio of means
Lodgepole pine (except StkCls 4)	27	161	12.5cm+	144	12.5cm+	0.597	1.115
Lodgepole pine (except StkCls 4)	27	186	9.0cm+	144	12.5cm+	0.580	1.288
Balsam (17.5cm+)	*7*	*107*	17.5cm+	*107*	17.5cm+	*0.903*	*0.993*
Aspen/Poplar (12.5cm+)	36	173	12.5cm+	121	12.5cm+	0.653	1.426
White Spruce (17.5cm+)	*17*	*216*	17.5cm+	*193*	17.5cm+	*0.478*	*1.115*
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	*11*	*105*	Sb/L: 17.5cm+; Pl: 12.5cm+	*61*	Sb/L: 17.5cm+; Pl: 12.5cm+	*0.148*	*1.732*
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	*11*	*147*	Sb/L: 9.0cm+; Pl: 9.0cm+	*70*	Sb/L: 12.5cm+; Pl: 12.5cm+	*0.059*	*2.106*
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	*11*	*118*	Sb/L: 17.5cm+; Pl: 9.0cm+	*61*	Sb/L: 17.5cm+; Pl: 12.5cm+	*0.169*	*1.939*

[21] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

Samples classed as "non-productive forest" (type id = 6) excluded

Table 4: Areas and weights for strata within population of interest defined as VT, 62C or 69C, type id 6 EXCLUDED.

Stratum	Population		Sample			
	Area (ha)	%	# of samples = n	%	Weight = area/n	Relative weight
Ac/At leading	376,128	28%	36	37%	10,448	1
Non-Ac/At leading	981,085	72%	62	63%	15,824	1.515
total	1,357213,		98			

A-5 List of VRI reports summarizing ecological and other timber attributes

Name	Description	Status*	Active /Inactive
	Sample Data Listings - for verification of input		
LL1	location Details	Not defined	Inactive
LT1	Large Tree Summary	Draft	Active
LT2	Small Tree and Stump Data	Draft	Inactive
LT3	Top Height and Site Tree Data	Draft	Inactive
LT4	Damage Agents and Loss Indicators	Draft	Inactive
LT5	Stem Map Data	Draft	Inactive
LE1	Ecological Data	Not defined	Inactive
LR1	Range Data	Not defined	Inactive
LC1	Coarse Woody Debris	Draft	Active
	Sample Cluster Reports		
CT1	Timber Summary	Draft used since '97	Active
CE1	Ecological Summary	Not defined	Inactive
CC1	Coarse WoodyDebris Summary	Draft	Active
CR1	Range Summary	Draft	Active
	Project reports		
PS1	Sample Plot Information	Draft	Active
PT1	Tree Counts	Draft	Active
PT2	Gross/Net Volume by Species and Utilization Limit	Not Defined	Inactive
PT3	Log Grade Distribution by Species	Draft	Inactive
PT4	Piece Size Distribution by Species	Draft	Inactive
PT5	Forest Health Information	Draft	Inactive
PT6	Wildlife Tree Information	Draft	Inactive
PT7	Old Growth and Succession Information	Not defined	Inactive
PE1	Ecological Information	Not defined	Inactive
PC1	Coarse Woody Debris Information (6 part report)	Draft	Active
PR1	Range Information	Draft	Active
PB1	Woody Biomass Volumes	Not defined	Inactive
PT8	Quality Assurance Report	Approved	Active
PT9	Quality Control report	Quality Control report	Active

** Reports that indicate "draft" status can be currently produced; other reports listed are planned for future availability.*

A-6 Plots of ground height and age versus inventory height and age, by strata (type id=6 included)

Ground Age versus Unadjusted Inventory Age

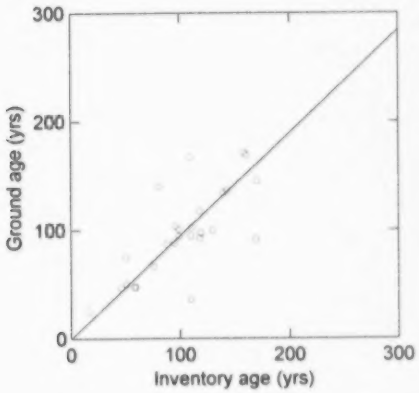


Fig. 1: LODGEPOLE PINE (except stk cls 4). Ground age versus unadjusted inventory age. The line on the graph represents the ratio of means.

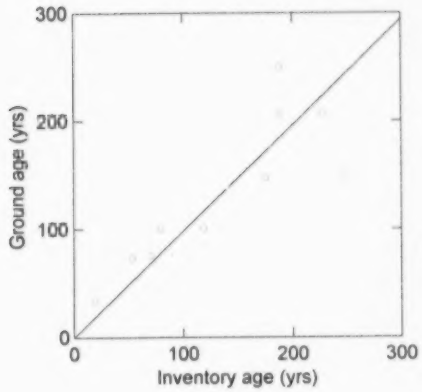


Fig. 2: BALSAM SAMPLES. Ground age versus unadjusted inventory age. The line on the graph represents the ratio of means.

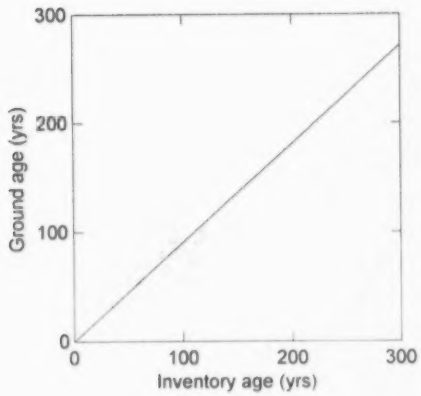


Fig. 3: ASPEN/POPLAR SAMPLES. Ground age versus unadjusted inventory age. The line on the graph represents the ratio of means.

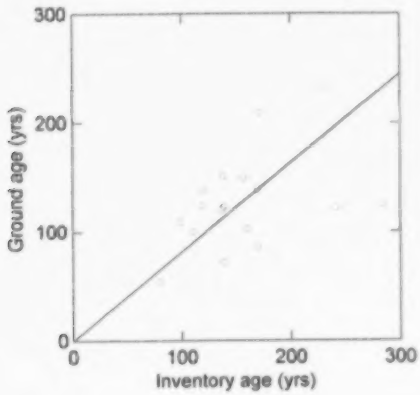


Fig. 4: WHITE SPRUCE SAMPLES.
Ground age versus unadjusted inventory age. The line on the graph represents the ratio of means.

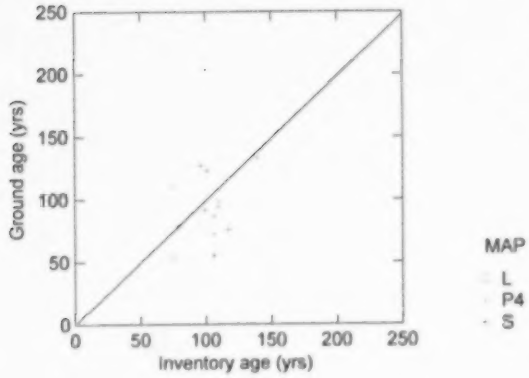


Fig. 5: BLACK SPRUCE, TAMARACK, & STOCKING CLASS 4 LODGEPOLE PINE SAMPLES.
Ground age versus unadjusted inventory age. The line on the graph represents the ratio of means.
O = tamarack
+ = black spruce
X = stocking class 4 Pl

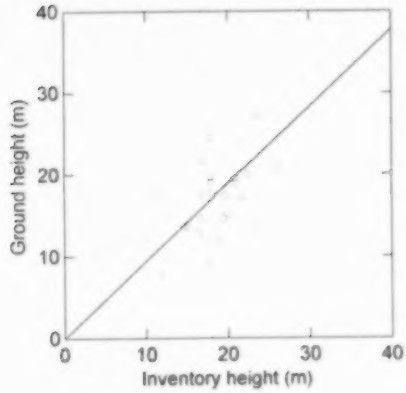


Fig. 6: LODGEPOLE PINE (except stk cls 4).
Ground height versus unadjusted inventory height. The line on the graph represents the ratio of means.

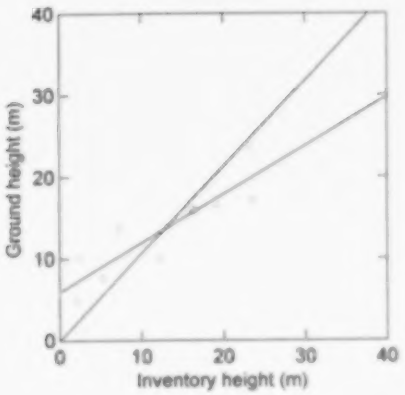


Fig. 7: BALSAM SAMPLES.
Ground height versus unadjusted inventory height. The lines on the graph represents the ratio of means (through the origin) and the least squares regression.

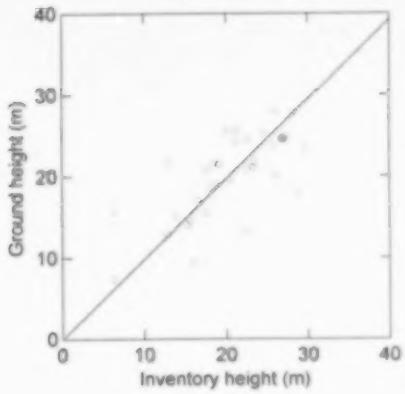


Fig. 8: ASPEN/POPLAR SAMPLES.
Ground height versus unadjusted inventory height. The line on the graph represents the ratio of means.

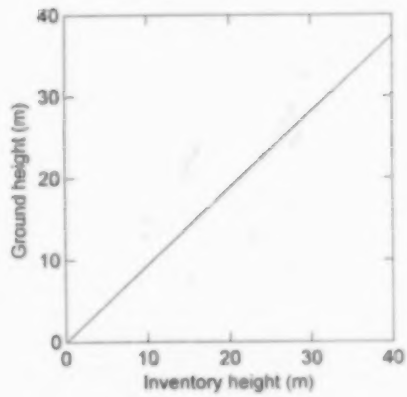


Fig. 9: WHITE SPRUCE SAMPLES.
Ground height versus unadjusted inventory height. The line on the graph represents the ratio of means.

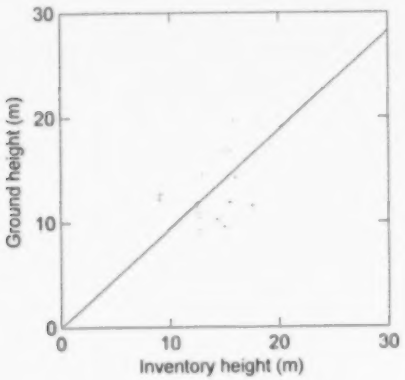


Fig. 10: BLACK SPRUCE, TAMARACK, & STOCKING CLASS 4 LODGEPOLE PINE SAMPLES.
Ground height versus unadjusted inventory height. The line on the graph represents the ratio of means.
O = tamarack
+ = black spruce
X = stocking class 4 Pl

A-7 Plots of ground volume versus "attribute-adjusted" inventory volume, by strata (type id=6 included)

Ground volume versus Inventory Volume with Ratio-adj'd Heights and Ages

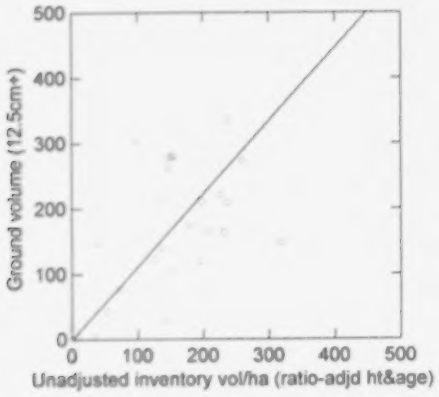


Fig. 22: LODGEPOLE PINE (except stk cls 4). Ground volume (12.5cm+ dbh) versus "attribute-adjusted" inventory volume. The line on the graph represents the ratio of means.

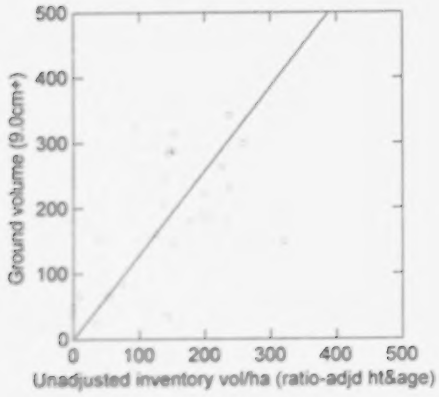


Fig. 23: LODGEPOLE PINE (except stk cls 4). Ground volume (9.0cm+ dbh) versus "attribute-adjusted" inventory volume. The line on the graph represents the ratio of means.

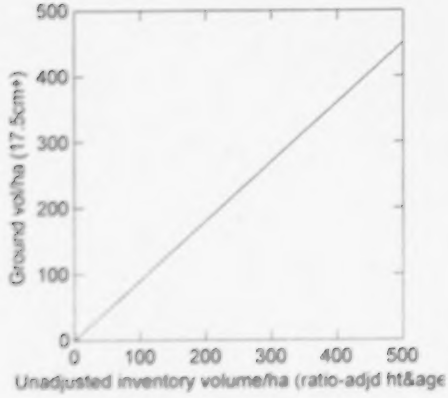


Fig. 24: BALSAM SAMPLES. Ground volume versus "attribute-adjusted" inventory volume. The line on the graph represents the ratio of means.

Ground volume versus Inventory Volume with Ratio-adj'd Heights and Ages

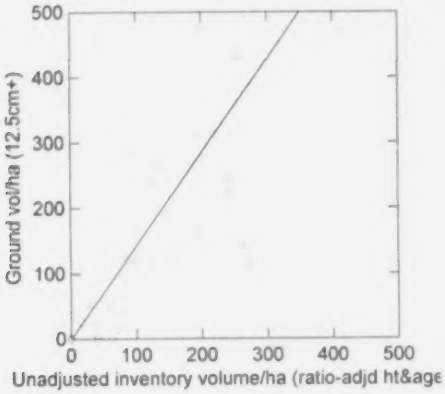


Fig. 25: ASPEN/POPLAR SAMPLES.
Ground volume versus "attribute-adjusted" inventory volume. The line on the graph represents the ratio of means.

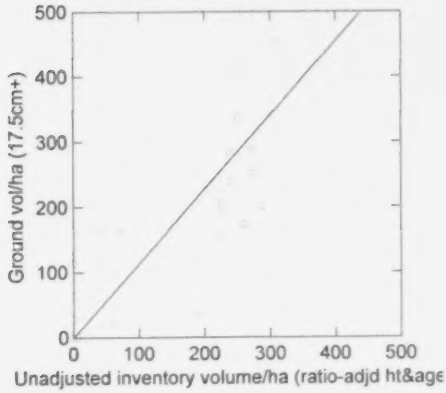


Fig. 26: WHITE SPRUCE SAMPLES.
Ground volume versus "attribute-adjusted" inventory volume. The line on the graph represents the ratio of means.

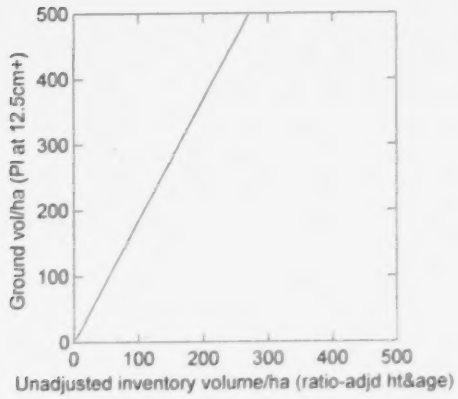


Fig. 27: BLACK SPRUCE, LARCH, & STOCKING CLASS 4 LODGEPOLE PINE SAMPLES.
Ground volume (12.5cm+ for Pl leading; 17.5cm+ for S&L) versus "attribute-adjusted" inventory volume. The line on the graph represents the ratio of means.
O = larch
+ = black spruce
X = stocking class 4 Pl

Ground volume versus Inventory Volume with Ratio-adj'd Heights and Ages

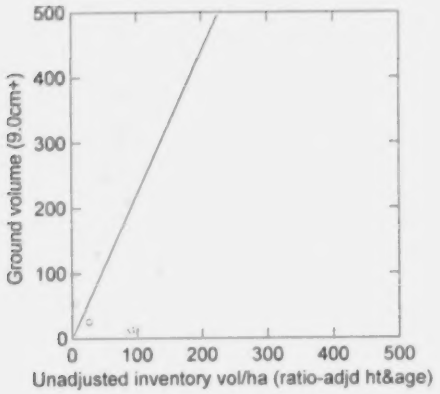


Fig. 28: BLACK SPRUCE, LARCH, & STOCKING CLASS 4 LODGEPOLE PINE SAMPLES.
Ground volume (9.0cm+ for all species) versus "attribute-adjusted" inventory volume. The line on the graph represents the ratio of means.
O = larch
+ = black spruce
X = stocking class 4 Pl

Ground volume versus Inventory Volume for Balsam Strata with Ratio-adj'd Age and LS Regression-adj'd Height

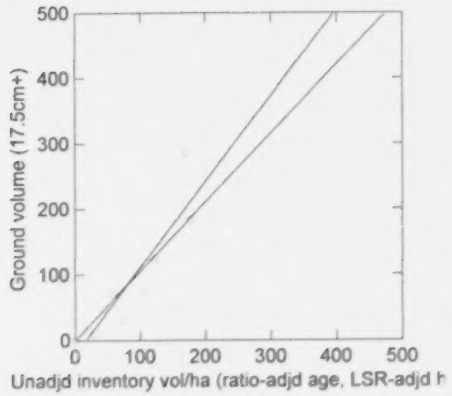


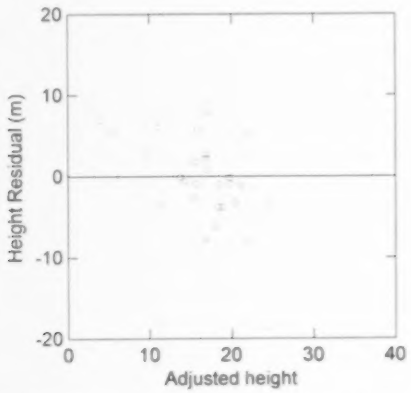
Fig. 29: BALSAM SAMPLES.
Ground volume (17.5cm+) versus "attribute-adjusted" inventory volume (using LSR for height). The lines on the graph represents the ratio of means (through the origin) and the least square regression.

A-8 Residuals Analysis

For each of the proposed height, age and volume adjustments, the adjusted values of the attribute were compared with the ground values in each stratum. The difference between the ground value and the adjusted value is called a residual value[22]. Residual values were plotted against the adjusted values to evaluate potential bias associated with the adjustment. A complete set of the plots of residuals versus adjusted values is provided in Appendix A-9.

For most attributes and most strata, the residuals are distributed in an approximately even horizontal band across the range of adjusted values. Figure 3 below illustrates this pattern. This horizontal band of residuals indicates an unbiased fit for the ratio adjustment.

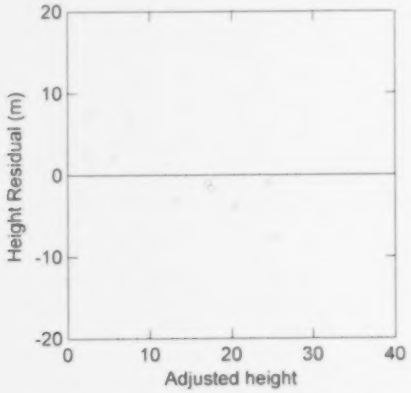
Figure 3: Plot of residual values versus adjusted height for the white spruce strata.



However, in some strata, the pattern of residuals indicated potential bias associated with the ratio adjustment model. As can be seen in Figure 4, there is a distinct downward sloping trend in the residuals in some strata. This indicates that the ratio adjustment tends to underestimate heights in short stands and overestimate heights in tall stands. Such a trend in the residuals means that the ratio-of-means model may not be appropriate for height adjustment in this stratum.

[22] Residual value = ground value – adjusted value.

Figure 4: Plot of residuals values versus adjusted height for the balsam strata.



To correct for this potential bias, various alternative adjustment models were considered. In particular, least squares regression (LSR) for height adjustment in the balsam strata was examined as a potential alternative to ratio-of means.

Table 9: Alternative Least Squares Regression height adjustment for Balsam strata.

Strata		***LSR Intercept***	***LSR Slope***
Balsam leading	n=10	5.954	0.595

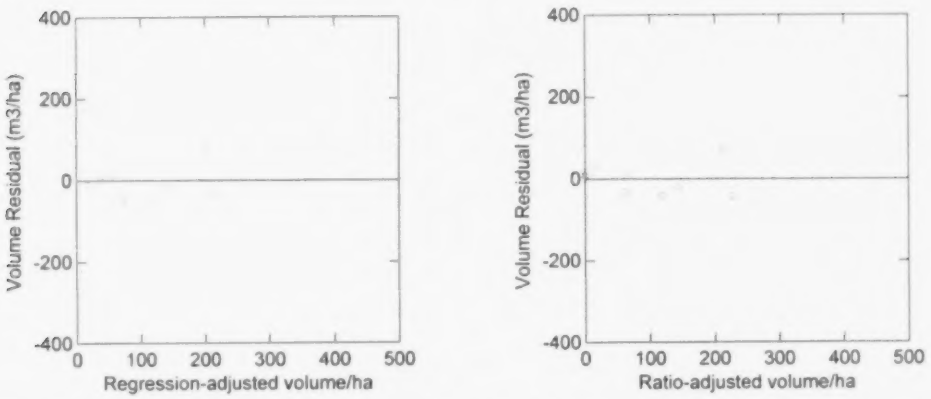
Since there were no obvious patterns of bias using a ratio-of-means adjustment for age in this stratum, ages were adjusted using the ratio in Table 3. Based on the ratio-adjusted ages and LSR-adjusted heights, inventory volumes were calculated in VDYP. A LSR approach for volume adjustment was then examined (see Table 10).

Table 10: Balsam strata least squares regression adjustment for volume (based on ratio-of-means adjustment for age and least squares regression adjustment for height).

Strata		***Mean grd vol/ha***	***Mean inventory vol/ha*** *(LSR-adj'd height)*	***LSR intercept***	***LSR Slope***
Balsam leading	n=10	84	80	-20.915	1.315

The LSR-adjusted volume residuals, generated from the Table 10 LSR were then compared with the ratio of means-adjusted volume residuals generated from Table 8. These residuals plots are shown in Figure 6.

Figure 5: Adjusted volume/ha residuals plots for LSR-adjusted volume and ratio-adjusted volume.



In the balsam strata in the Dawson Creek VRI data, the apparent bias using a ratio-of-means height adjustment did not appear in the ratio-adjusted volumes. The LSR-adjustment for height and volume produced significant intercept values that could have implications if applied in the TSR context. Although a pattern of bias was observed for the ratio-of-means height adjustment[23], the ratio-adjusted volumes that followed did not show any similar bias patterns. As a result, ratio-of-means was recommended for age, height and volume in all strata in this analysis. However, further study of alternative adjustment methodologies and potential implications for their usage is recommended.

[23] The implication of this bias on adjusted height and site index is unclear.

A-9 Residuals plots

RESIDUALS PLOTS FOR AGE

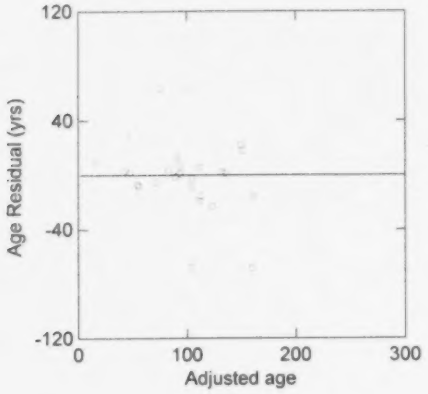


Fig. 11: LODGEPOLE PINE (except stk cls 4). Residuals for predicted age (i.e. ratio-adjusted age).

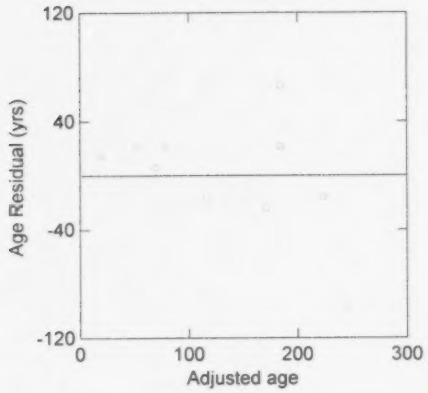


Fig. 12: BALSAM SAMPLES. Residuals for predicted age (i.e. ratio-adjusted age).

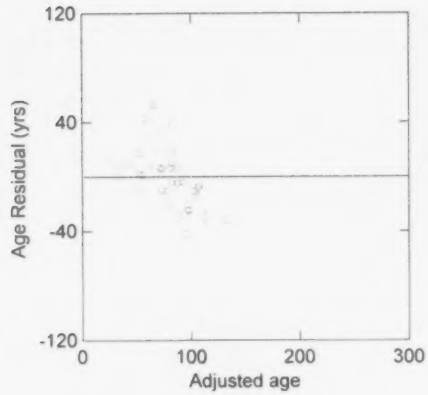


Fig. 13: ASPEN/POPLAR SAMPLES. Residuals for predicted age (i.e. ratio-adjusted age).

RESIDUALS PLOTS FOR AGE

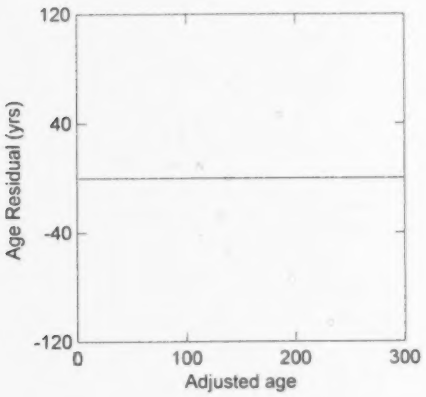


Fig. 14: WHITE SPRUCE SAMPLES. Residuals for predicted age (i.e. ratio-adjusted age).

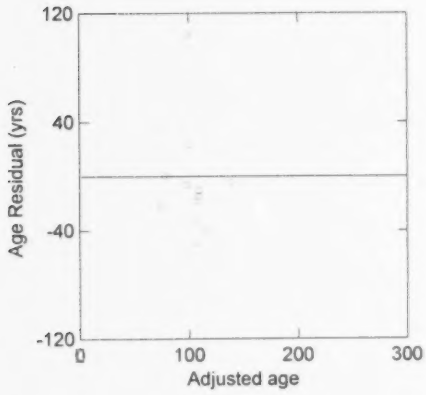


Fig. 15: BLACK SPRUCE, LARCH, & STOCKING CLASS 4 LODGEPOLE PINE SAMPLES. Residuals for predicted age (i.e. ratio-adjusted age).

RESIDUALS PLOTS FOR HEIGHT

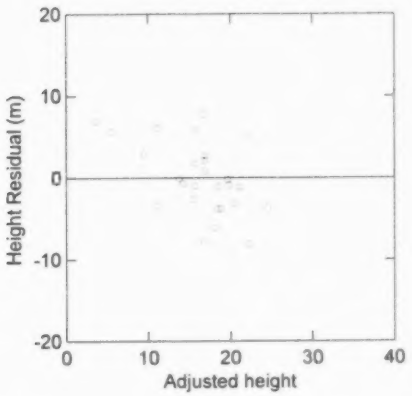


Fig. 16: LODGEPOLE PINE (except stk cls 4). Residuals for predicted height (i.e. ratio-adjusted height).

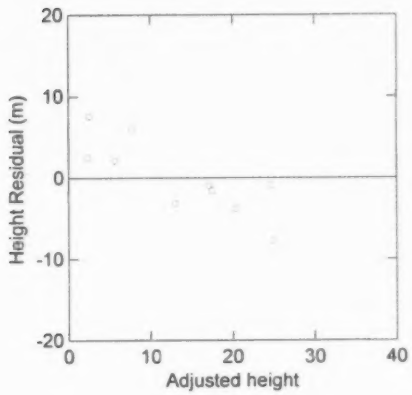


Fig. 17: BALSAM SAMPLES. Residuals for predicted height (i.e. ratio-adjusted height).

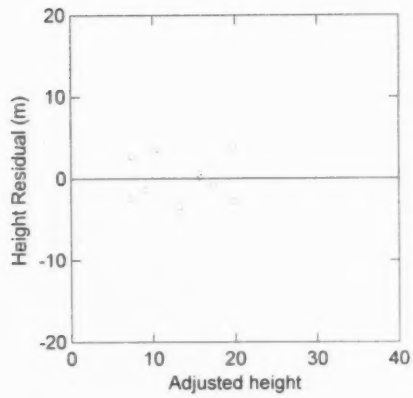


Fig. 18: BALSAM SAMPLES. Residuals for predicted height (i.e. least squares regression-adjusted height).

RESIDUALS PLOTS FOR HEIGHT

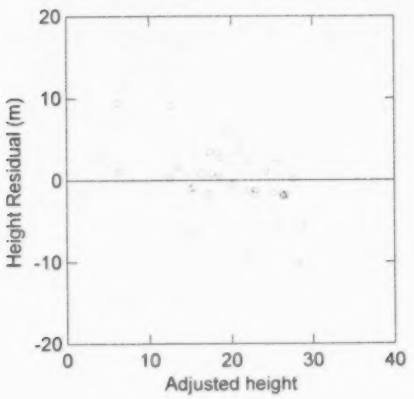


Fig. 19: ASPEN/POPLAR SAMPLES. Residuals for predicted height (i.e. ratio-adjusted height).

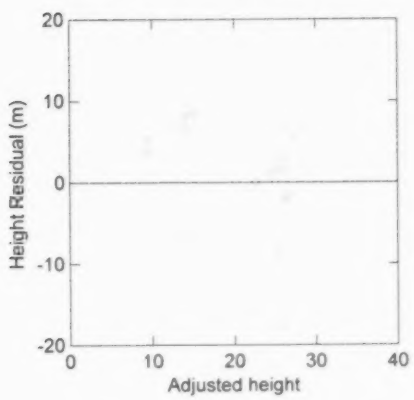


Fig. 20: WHITE SPRUCE SAMPLES. Residuals for predicted height (i.e. ratio-adjusted height).

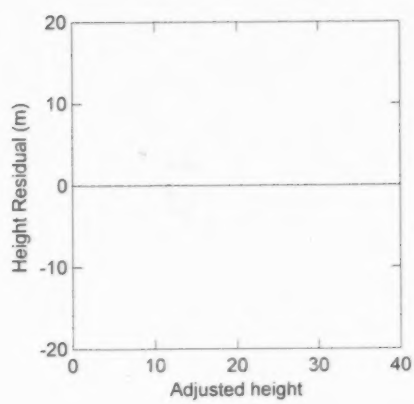


Fig. 21: BLACK SPRUCE, LARCH, & STOCKING CLASS 4 LODGEPOLE PINE SAMPLES. Residuals for predicted height (i.e. ratio-adjusted height).

RESIDUALS PLOTS FOR RATIO-ADJUSTED VOLUME

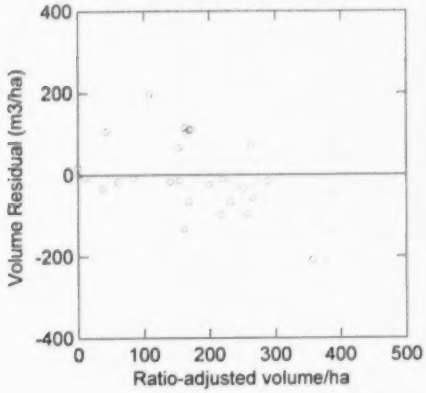


Fig. 30: LODGEPOLE PINE (except stk cls 4). Residuals for ratio-adjusted volume (at 12.5 cm+ dbh utilization).

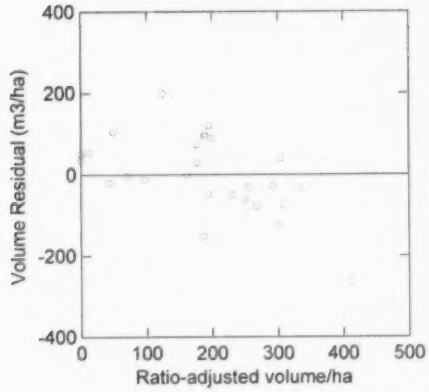


Fig. 31: LODGEPOLE PINE (except stk cls 4). Residuals for ratio-adjusted volume (at 9.0cm+ dbh utilization).

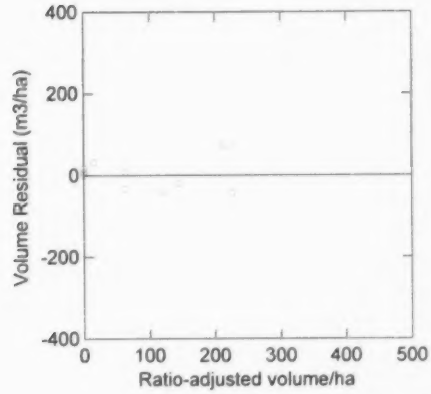


Fig. 32: BALSAM SAMPLES. Residuals for ratio-adjusted volume (at 17.5 cm+ dbh utilization).

RESIDUALS PLOTS FOR RATIO-ADJUSTED VOLUME

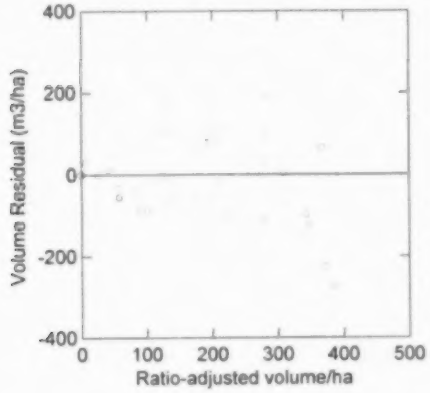


Fig. 33: ASPEN/POPLAR SAMPLES. Residuals for ratio-adjusted volume (at 12.5 cm+ dbh utilization).

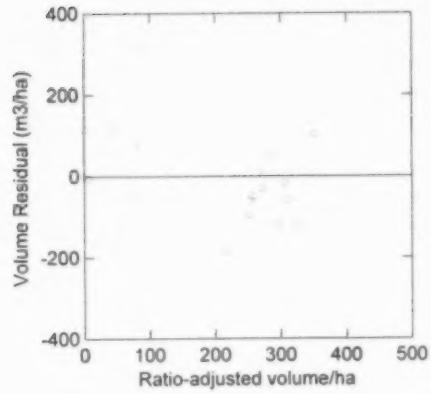


Fig. 34: WHITE SPRUCE SAMPLES. Residuals for ratio-adjusted volume (at 17.5 cm+ dbh utilization).

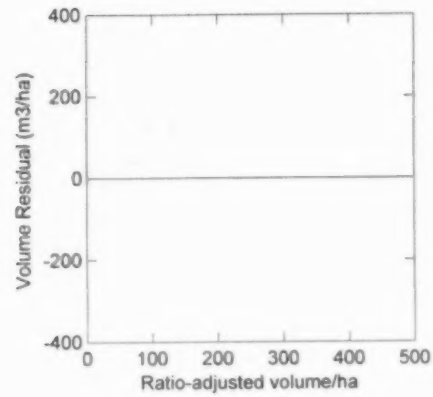


Fig. 35: BLACK SPRUCE, LARCH, & STOCKING CLASS 4 LODGEPOLE PINE SAMPLES. Residuals for ratio-adjusted volume (at 12.5 cm+ dbh for Pl leading; 17.5cm+ dbh for S&L).

RESIDUALS PLOTS FOR RATIO-ADJUSTED VOLUME

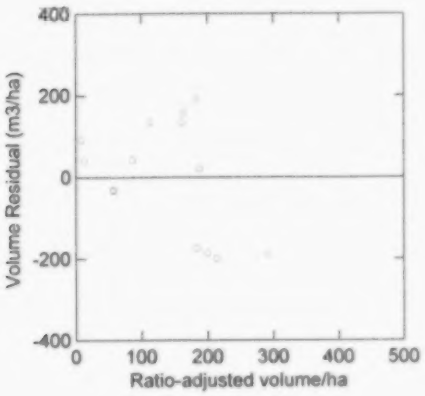


Fig. 36: BLACK SPRUCE, LARCH, & STOCKING CLASS 4 LODGEPOLE PINE SAMPLES.
Residuals for ratio-adjusted volume (at 9.0 cm+ dbh for all species).

RESIDUALS PLOTS FOR BALSAM ADJUSTED VOLUME

(where "attribute-adj'd" volume is based on ratio-adj'd age and LS regression-adj'd height)

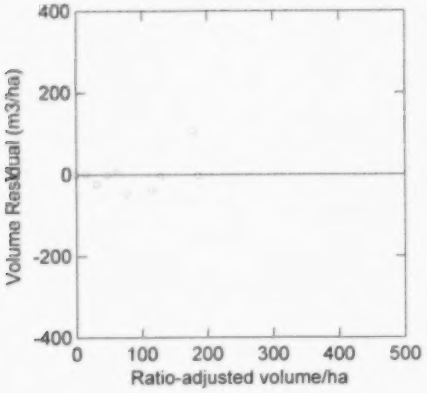


Fig. 37: BALSAM SAMPLES. Residuals for ratio-adjusted volume. (see table 3a)

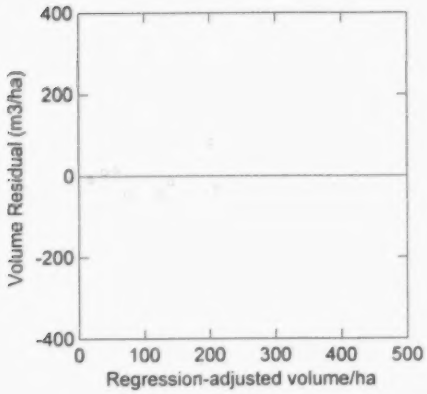


Fig. 38: BALSAM SAMPLES. Residuals for LS regression-adjusted volume. (see table 3a)

A-10 Data sorting and sample selection in Dawson Creek

The selection of the samples in the Dawson Creek Forest District occurred as follows:

1) Assembled sampling frame.

2) Using ordered systematic sampling, drew 10,000 potential samples (list was not sorted appropriately - described below).

3) Systematically drew 330 samples from the 10,000 potential samples.

4) Discovered crown closure missing in TFL48 (resulting in incorrect assignment of BCLCS codes - many VT polygons coded as VN).

5) Came up with alternate means of assigning BCLCS codes which led to significantly more VT overall (replace all bclcs_code with 'VT' for spcs_1 <> ' ' and cr_cl_pct = 0 and age_proj >= 20).

6) Reduced sample size in the non-VT from 80 to 50 (due to proportional reduction in non-VT area), thus total Provincial VRI sample size went from 330 to 300.

7) As ground sampling had begun, had to work with the existing sample list (330) and modify.

8) Randomly dropped 26 VT samples from the 330, and randomly added 26 from the new VT, reduced the non-VT sample size to 50 from 80 by randomly eliminating 30 samples.

9) Several maps were missed from the initial selection of 330 (and 10,000 potential samples) as the code used did not determine a large enough interval for the ordered systematic. In addition, the initial sort was incorrect (sorted on map/poly).

10) Randomly reduced the number of samples in the maps in area not missed and randomly added same number of samples to missed areas to compensate (proportional to area). 11 VT samples and 17 non-VT samples were affected.

11) 5 map numbers were mixed up in Excel; samples were put in the wrong polygons. These should be excluded from analysis.

A-11 Sample size and sampling error

Table 1: Sample Size Estimates for At/Ac polygons classed as VT in Dawson Creek TSA[24]

NOTE: CV is from VRI ratio of means at 12.5cm+ dbh utilization, net dwb (n=36)

where n = t^2 * CV^2 / PE^2 (t at alpha/2, n-1)

At/Ac leading VT polygons

Sample size for a given CV and PE:

CV= 62.3%
alpha= 0.05

Error % PE	Sample size n
10%	152
15%	69

CV= 62.3%
alpha= 0.1

Error % PE	Sample size n
10%	107
15%	49

Sample size for a given CV and n:

CV= 62.3%
alpha= 0.05

Sample size n	Error % PE
36	21%
50	18%
86	13%
100	12%
120	11%
130	11%
150	10%

CV= 62.3%
alpha= 0.1

Sample size n	Error % PE
36	18%
50	15%
86	11%
100	10%
120	9%
130	9%
150	8%

Note: EXCEL function for tinv provides a t-value of the 'half interval' for a specified alpha

Sample size formula is not 'automatic'; degrees of freedom for t-value must be iterated.

[24] Note that there were no Ac/At leading polygons among the samples that were type id 6 (non-productive).

Table 2: Sample Size Estimates for non-At/Ac polygons classed as VT in Dawson Creek (includes type id 6)

NOTE: CV is from VRI ratio of means at 12.5cm+/17.5cm+ dbh utiln, net dwb (n=70)

where n = t^2 * CV^2 / PE^2 (t at alpha/2, n-1)

non-At/Ac leading VT polygons

Sample size for a given CV and PE:

CV=	65.2%	CV=	65.2%
alpha=	0.05	alpha=	0.1

Error % PE	Sample size n	Error % PE	Sample size n
10%	166	10%	117
15%	75	15%	53

Sample size for a given CV and n:

CV=	65.2%	CV=	65.2%
alpha=	0.05	alpha=	0.1

Sample size n	Error % PE	Sample size n	Error % PE
36	22%	36	18%
50	19%	50	15%
86	14%	86	12%
100	13%	100	11%
120	12%	120	10%
130	11%	130	9%
150	11%	150	9%
175	10%	175	8%

Note: EXCEL function for tinv provides a t-value of the 'half interval' for a specified alpha

Sample size formula is not 'automatic'; degrees of freedom for t-value must be iterated.

Table 3: Sample Size Estimates for non-At/Ac, VT polygons (excludes type id 6) in Dawson Creek TSA

NOTE: CV is from VRI ratio of means at 12.5cm+/17.5cm+ dbh utiln, net dwb (n=62)

where n = t^2 * CV^2 / PE^2 (t at alpha/2, n-1)

non-At/Ac leading VT polygons (type id 6 excluded)

Sample size for a given CV and PE:

CV= 61.8%
alpha= 0.05

Error % PE	Sample size n
10%	149
15%	68

CV= 61.8%
alpha= 0.1

Error % PE	Sample size n
10%	105
15%	48

Sample size for a given CV and n:

CV= 61.8%
alpha= 0.05

Sample size n	Error % PE
36	21%
50	18%
86	13%
100	12%
120	11%
130	11%
150	10%
175	9%

CV= 61.8%
alpha= 0.1

Sample size n	Error % PE
36	17%
50	15%
86	11%
100	10%
120	9%
130	9%
150	8%
175	8%

Note: EXCEL function for tinv provides a t-value of the 'half interval' for a specified alpha

Sample size formula is not 'automatic'; degrees of freedom for t-value must be iterated.

A-12 Ground data and unadjusted inventory data

Dawson Creek Timber Supply Area

Documentation of Vegetation Resources Inventory Interim Analysis: ADDENDUM

PREPARED BY:
MINISTRY OF FORESTS
RESOURCES INVENTORY BRANCH

JANUARY 25, 2001

1. Background

As outlined in section 3.1 of the "Dawson Creek Vegetation Resources Inventory Interim Analysis" report, a total of 50 additional samples in the aspen/poplar strata were planned for the 2000 field season. This sampling has not yet been completed; only 41 samples out of the original 50 planned were actually established in 2000. However, the 41 samples completed thus far were compiled and combined with the 36 aspen/poplar samples that were collected in 1998 and 1999. A new set of adjustment factors for the aspen/poplar stratum, based on the 77 samples completed to date, was developed.

In addition, NVAF sampling was completed for Dawson Creek in 2000. All VRI samples completed to date (1998, 1999 and 2000) were compiled to provide NVAF volumes as well as loss factor volumes.

2. Analysis and Results

For details on the analysis methodology, interpretation and application, please refer to the report "Dawson Creek Vegetation Resources Inventory Interim Analysis".

Data changes and assumptions that were directly related to the analysis of the data are documented in Appendix A-1. Scatter plots showing the relationships between the ground attributes and inventory attributes (height and age) and between ground volume and "attribute-adjusted" inventory volume are shown in Appendix A-2.

Means and confidence intervals for ground attributes and unadjusted inventory attributes are shown below in Table 1. These summary statistics are based on the 77 samples collected to date in the aspen/poplar stratum. Note that ground height was missing for ten samples and and ground age was missing for two samples.

Table 1: Descriptive statistics for aspen/poplar sample attributes, before adjustment.

Attribute and statistic	*Unadjusted inventory sample attribute values*	*Ground sample attribute values*
Height (m)		
n	77	67
mean	19.7	19.1
95% conf. interval	18.3 – 21.1	17.7 – 20.6
Age (years)		
n	77	75
mean	78	74
95% conf. interval	71 – 84	68 – 81
Volume (m^3/ha) 12.5cm+ dbh net dwb		
n	77	77
mean	118	146 (loss factor) 158 (NVAF)
95% conf. interval	100 – 137	118 – 174 (loss factor) 127 – 189 (NVAF)

Ratio-of-means adjustment factors were developed for inventory height and age. These are shown in Table 2.

Table 2: Height and age adjustment factors (ratio of means), for aspen/poplar.

Attribute	*n*[25]	*Mean ground value*	*Mean inventory value*	*Correlation*	*Ratio-of-means Adjustment factor*
Age					
All samples to date	75	74	78	0.463	0.951
Height					
All samples to date	67	19.1	19.8	0.525	0.969

[25] The means in the numerator and denominator of the ratio-of-means adjustment factors were based on the same set of samples. There were several samples for which ground ages and/or heights were not available. For such samples, the corresponding inventory age and/or height was removed from the calculation of the mean for the ratio-of-means adjustment factor. Hence, in the case of height, the adjustment factor is based on the 67 samples for which both ground and inventory heights were available.

These height and age adjustment factors were applied to the inventory heights and ages for all aspen/poplar samples and an "attribute-adjusted" inventory volume was produced using VDYP v.6.6d. An adjustment factor for volume – defined as the ratio between the mean ground volume and the mean "attribute-adjusted" inventory volume – was then calculated and is shown in Table 3. Note that two volume adjustment factors are shown: one based on loss factor ground volumes and one based on NVAF ground volumes. Plots of residuals for all adjustment factors (height, age and volume) are available in Appendix A-3.

Table 3: Volume adjustment factors (ratio of means), for aspen/poplar. All volumes are at the 12.5cm + utilization net dwb.

Attribute	*n*	*Mean ground volume*	*Mean "attribute-adjusted" inventory volume*	*Correlation*	*Ratio-of-means Adjustment factor*
Loss factor volume (m^3/ha)					
All samples to date	77	146	109	0.454	1.338
NVAF volume (m^3/ha)					
All samples to date	77	158	109	0.479	1.449

To provide an indication of the sampling error achieved in the adjustment process, the mean ground volumes (loss factor and NVAF) are compared against the unadjusted mean inventory volume in Table 4. In addition to reporting the sampling error for all samples established to date (n=77), the sampling error is also shown for the 1998/99 and 2000 sets of samples individually.

Table 4: Comparison of ground volumes and unadjusted inventory volumes for aspen/poplar.

Study	*n*	*Mean ground loss factor vol/ha*	*Mean ground NVAF vol/ha*	*Mean inventory vol/ha*	*LF volume ratio*	*Sampling error % for ratio (@95%)*	*NVAF volume ratio*	*Sampling error % for ratio (@95%)*
1998/99	36	172.86	185.24	130.28	1.33	21.1%	1.42	20.0%
2000	41	122.58	134.59	107.97	1.14	32.4%	1.25	32.9%
Combined	77	146.09	158.27	118.40	1.23	18.6%	1.34	18.4%

3. Appendices

A-1 Data Issues Log

Sample #	Issue	Action required or issue resolution
all	No sample weights were applied to combine the deciduous strata samples from the 1999 VRI data and the 2000 VRI data. Is this correct?	Examine sampling plan; have Sam and region/district staff advise on weighting requirement. OK SO LONG AS LANDBASE DOESN'T CHANGE.
all	12.5 cm+ utilization is used for the adjustment ratios. All ground volumes are compiled using loss factors and NVAF.	Is this acceptable for the region/district? YES. REPORT BOTH NVAF AND LOSS FACTOR RATIOS.
1999 VRI samples	NVAF compilation for 1999 VRI samples was done using the manually edited 1999 ascii flat file (NOT THE ORACLE DATABASE). See Dawson Creek report and Bob Krahn's Dec. 2/99 e-mail for details of the changes that were made.	Confirm that this is OK. YES. NOTE CHANGES TO THREE 1999 SAMPLE HEIGHTS (# 33,126, 287) TO BE CONSISTENT WITH THE 2000 SAMPLES (see below).
33, 126, 287	In the 1999 analysis, the suitable codes for height were manually changed from N to Y to provided heights for samples where they would otherwise be missing. In the 2000 analysis, the suitability code for heights was not changed.	FOR THESE SAMPLES, CHANGE THE SUITABILITY CODE BACK TO ITS ORIGINAL "N" AND CALL THE HEIGHTS MISSING FOR THESE SAMPLES. Note that only one of these samples is in the aspen/poplar stratum.
547	Gary's attribute list indicated map 93P024 poly 990 for this sample but Matt's list indicated map 093P024 poly 129.	This mapsheet was re-inventoried. Matt & Sam indicated that 990 is the correct poly to use. Gary provided new attributes for this poly in file 990.dbf.
534, 541, 542, 576	The ownership of these samples on the FIP were other than 62C or 69C. Are they in the population of interest?	Matt checked the FC1's and these samples ARE either 62C or 69C hence are in the population of interest.
Extra 1999 samples in compilation files	25 "extra" samples i.e. samples that were not included in the 1999 analysis were identified in this year's compilation for DC from the Oracle database. What are these samples? Were they "missed" last year?	Matt confirmed that the ownership for 23 of these 25 samples was other than either 62C or 69C hence they were not included in last year's analysis because they did not meet the ownership criterion for the population. The remaining 2 samples (#46 & #83) were dropped from last year's analysis because they had been logged.
510, 517, 549, 516, 542, 544, 553	Missing heights for these samples.	Broken tops; no suitable heights. Call ground heights missing.
548	Mean height of TLS trees changed from Alf's first compilation (Dawson_Ck_with_Nvaf2_smy_ncs.xls) to Gitte's compilation from 7.0 to 8.8m. There were no other changes to the average heights and ages between these compilations. Were there changes made to the database to explain this?	Use height of 7.0 m per Gitte.
547	On ground, >50% of ba at 4cm occurs at 17.5cm+. Pl leading at 17.5cm+ (no ht or age). At leading at 12.5cm+ and lower (height & age available). Can we use this deciduous ht & age??	Use At ht & age (per Sam)
536	AT leading on ground but only age (54) but no height. Age and Ht (40yrs, 6.2m) for second spp. AC. Use AC height and age data??	Use Ac ht and age

A-2 Plots of ground attributes versus unadjusted inventory attributes

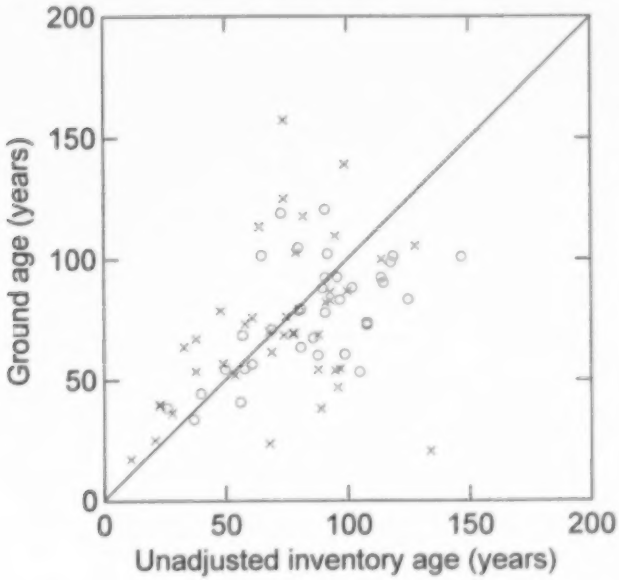


Fig. 1: Ground age versus unadjusted inventory age. O's correspond with samples collected in 1998/1999 and X's correspond with those collected in 2000.

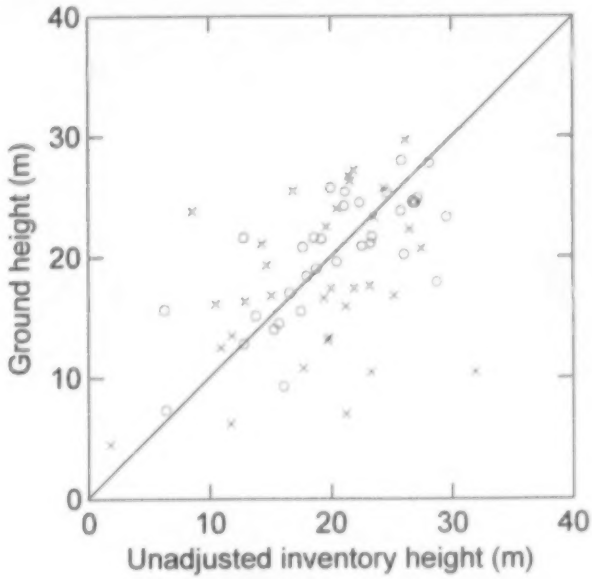


Fig. 2: Ground height versus unadjusted inventory height. O's correspond with samples collected in 1998/1999 and X's correspond with those collected in 2000.

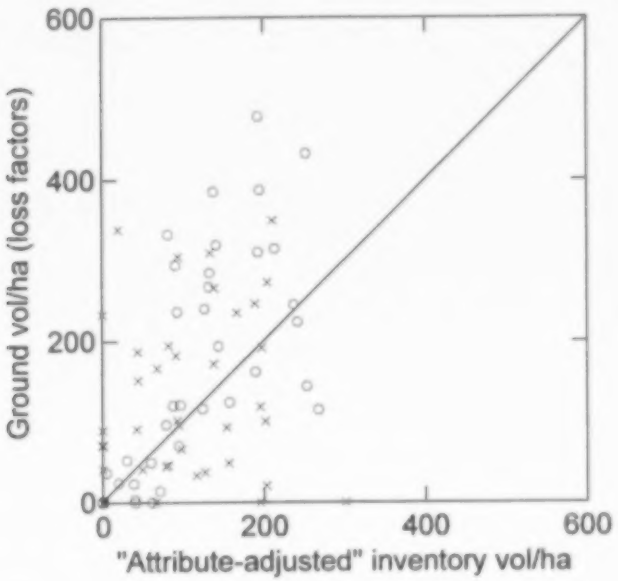


Fig. 3: Ground volume/ha (loss factor) at 12.5cm+ dbh net dwb versus "attribute-adjusted" inventory volume/ha. O's correspond with samples collected in 1998/1999 and X's correspond with those collected in 2000.

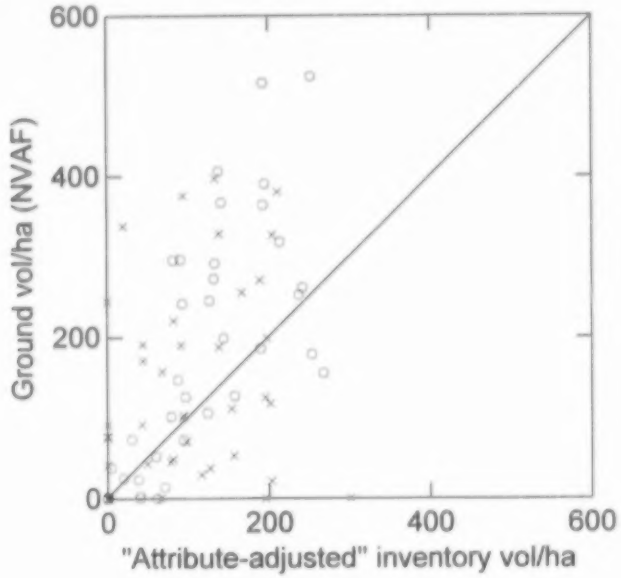


Fig. 4: Ground volume/ha (NVAF) at 12.5cm+ dbh net dwb versus "attribute-adjusted" inventory volume/ha. O's correspond with samples collected in 1998/1999 and X's correspond with those collected in 2000.

A-3 Plots of residuals

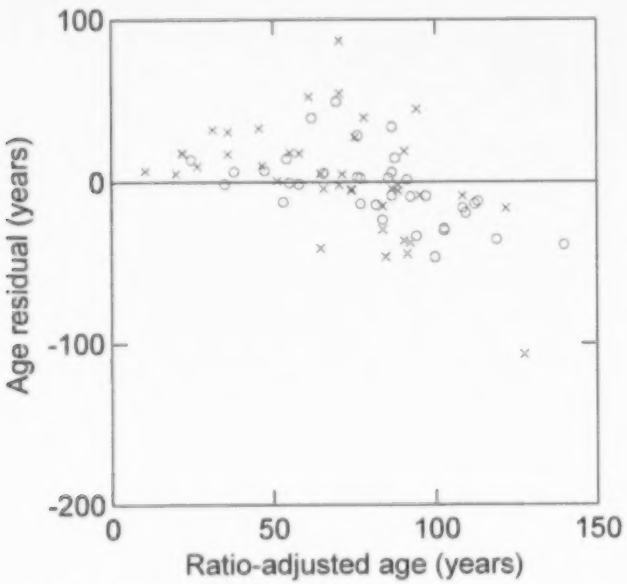


Fig. 1: Age residual (ground age – ratio-adjusted age) versus ratio-adjusted inventory age. O's correspond with samples collected in 1998/1999 and X's correspond with those collected in 2000.

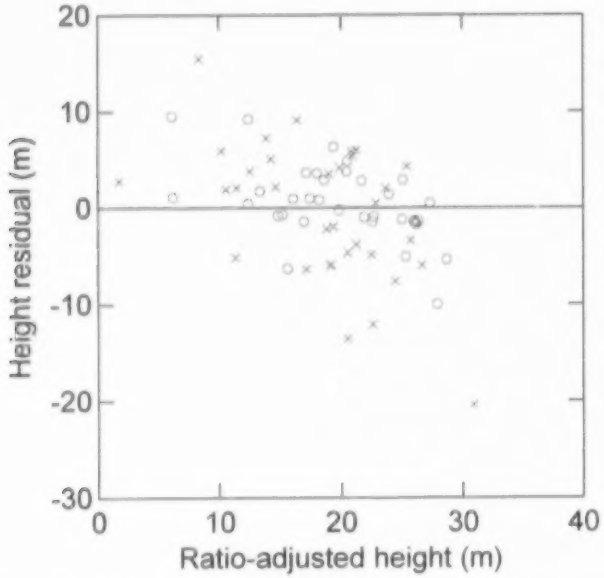


Fig. 2: Height residual (ground height – ratio-adjusted height) versus ratio-adjusted inventory height. O's correspond with samples collected in 1998/1999 and X's correspond with those collected in 2000.

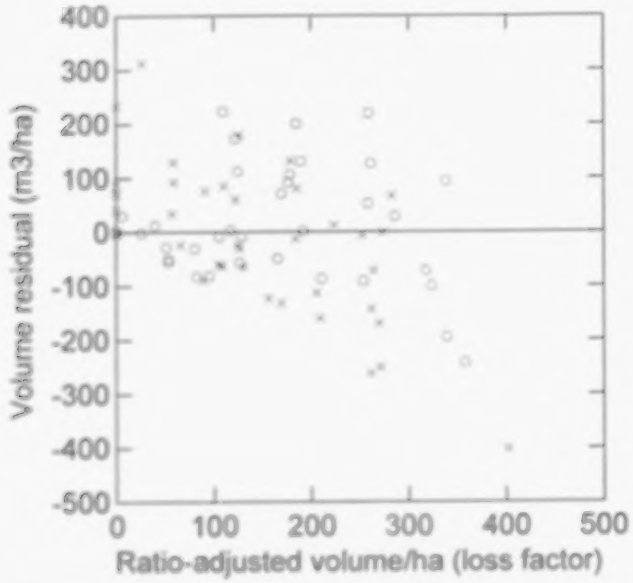


Fig. 3: Loss factor volume/ha residual (ground volume – ratio-adjusted volume) versus ratio-adjusted volume/ha. O's correspond with samples collected in 1998/1999 and X's correspond with those collected in 2000.

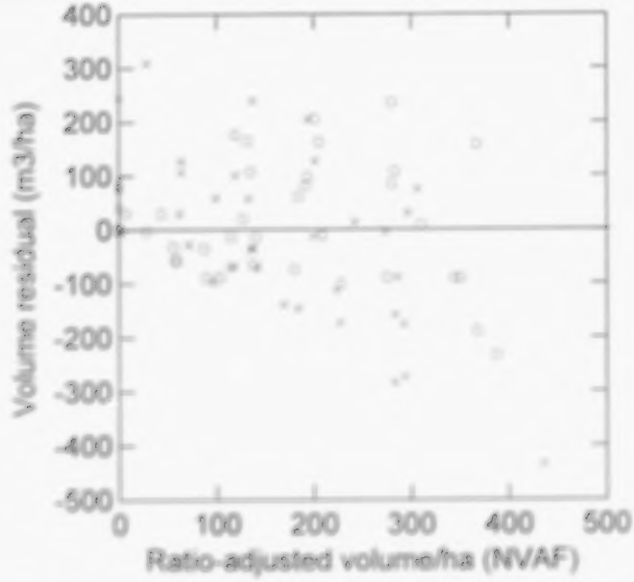


Fig. 4: NVAF volume/ha residual (ground volume – ratio-adjusted volume) versus ratio-adjusted volume/ha. O's correspond with samples collected in 1998/1999 and X's correspond with those collected in 2000.

Dawson Creek
Timber Supply Area

Documentation of
Vegetation Resources Inventory

ADDENDUM No. 2

PREPARED BY:
MINISTRY OF SUSTAINABLE RESOURCE MANAGEMENT
TERRESTERIAL INFORMATION BRANCH

March, 2002

FOREST
RENEWAL BC

I. Executive Summary

This report describes the results of analysis completed to date on the Dawson Creek TSA Vegetation Resources Inventory (VRI) ground sample inventory. This is the second addendum to the initial analysis completed in June 22,2000.[1] The report also references content from the previously developed "Dawson Creek Forest District Vegetation Resources Inventory Ground Sampling Plan, Revised Final Report, October 1997."

The material presented in this report was made available for the current Timber Supply Review (TSR) and was developed in conjunction with staff from Ministry of Sustainable Resource Management, Terrestrial Information Branch, Prince George Region and District, and Ministry of Forests, Timber Supply Branch and Prince George Region. It is the expectation that the inventory files will be adjusted using the results provided in this report and applied in the upcoming timber supply review. Funding was largely provided by Canfor Corporation through Forest Renewal B.C. Jahraus and Associates Ltd. provided analysis support.

This analysis focused on the development of adjustment factors for height, age and volume to support the current timber supply analysis. The process used to derive these adjustments is based on the interim (Fraser protocol) and may change in the future. In the "Fraser Protocol", the statistical adjustment of inventory attributes consists of a set of steps and assumptions used to develop and then apply adjustment factors to the FIP file attributes of height and age and the volume predicted using VDYP. The goal of the adjustment is to remove any overall bias in the inventory when compared against the VRI ground data for the attributes that are adjusted. The principal steps in this adjustment process are :

1. Adjust height and age.
2. Based on the adjusted height and age, use VDYP to computed inventory volume (attribute - adjusted inventory volume)
3. Use the compiled ground volumes to then adjust the "attribute-adjusted" inventory volume.
4. Check to ensure that the adjustments were correctly applied to the inventory files

The population sampled for this study is the Vegetated Treed (VT) portion of the Dawson Creek TSA, for inventory stand ages 0+, excluding private lands, parks and other legally recognized protected areas, TFLs and woodlots. For this analysis, Forest Inventory Planning file (FIP) database descriptor type ID 6, non-productive samples were also removed.[2] Sample polygons were selected over the entire target population using stratified ordered systematic (OS) sampling. This project has spanned four years of ground sampling and resulted in the use of 128 ground sample plots. The first two years of sampling proportionally targeted all forest types across the

[1] http://www.for.gov.bc.ca/resinv/REPORTS/InvAdjReports/InvAdjReports.htm

[2] ground sample plots established in type ID 6 stands were excluded from the analysis as they did not represent the timber supply landbase

land base. In the third and fourth years samples were targeted in stands leading in aspen/poplar and balsam respectively. NVAF sampling was also completed in the latter half of this project.

The material provided in this report describes the following:

Table 1 : Summary of final overall adjustment ratios recommended for use in the current Timber Supply Review.

Tables 2 to 5: Summary of possible height/age/volume adjustment factors available for adjustment.

Tables 6 and 7: Overall volume impact of applying the height/age and volume adjustment factors by strata using traditional loss factors and the VRI net factoring/NVAF system.

Based on the original project objectives (achieve a sampling error of the ratio of 10% at the 95% of probability for net merchantable volume for the VT population age 0 +) this analysis reported an overall loss factor derived volume ratio of 1.125 with a sampling error of 12% and an overall NVAF ratio of 1.19 with an 11.9% sampling error.

For the aspen/poplar strata population sampling errors of 18.7% and 18.4% were achieved for loss factor and net factoring/ NVAF respectively.[3]

Stakeholders need to decide if the sampling errors achieved in this study are acceptable.

The Ministry of Forests, Timber Supply Branch is currently testing the impact of these adjustments against the current files to be used in the timber supply analysis.

The total contract costs to date on this project are approximately $ 385,000 for field sampling and $10,000 for planning and analysis.

[3] The original sampling objective for the At/Ac strata was 15% at the 95% level of probability.

2. Analysis and Results

The following summary presents the:

i) The adjustment factors to apply against the age, height and volume adjustment fields on the FIP inventory data base.
ii) The complete set of tables and graphs used in the analysis to determine the ratios.
iii) A brief summary of data issues associated with this analysis.

Inventory file adjustment checks are to be provided at a later date.

2.1 Adjustment Factors

Table 1. Final adjustment ratios

Stratum	Subcategory	Compiler utilization (cm.)	Inventory age range (years)	Age adjustment ratio	Height adjustment ratio	Loss Factor Volume Adjustment ratio	NVAF Volume adjustment ratio
Bl		17.5	All ages	0.940	0.981	1.10	1.320
At, Ac		12.5	<=80	1.236	1.151	1.417	1.487
		12.5	>80	0.855	0.951	1.345	1.479
Sw		17.5	All ages	0.804	1.024	1.002	1.103
Pl (except stkcl_pr =4)	pine	12.5	age_prj<=60	0.934	1.155	0.617	0.617
		12.5	60<age_prj<=120	0.991	0.948	1.340	1.426
		12.5	age_prj>120	0.887	0.827	1.019	1.110
	'short' pine	9.0	60<age_prj<=120	0.991	0.948	1.472	1.567
		9.0	age_prj>120	0.887	0.827	1.198	1.300
Sb, L, Pl (stkcl_pr =4)		17.5/17.5/12.5	All ages	0.899	0.957	1.956	2.032

Note: "short" pine defined as: (adjusted height <19.5m and adjusted age >80 years)

ii) Analysis Summary

Table 2: Height adjustment ratios (ratio of means), by strata. "Non-productive forest" samples (typeid=6) excluded.

Strata[4]	*n*	Height adjustment: Ratio of means			
		Mean ground height	Mean inventory ht	Correlation	Ratio of means
Lodgepole pine (except StkCls 4)	24	15.8	17.0	0.545	0.929
Inventory age <=120	17	15.4	15.6	0.500	0.985
Inventory age >120	7	16.8	20.4	0.781	0.827
Inventory age <60	5	10.8	9.4		1.155
Inventory age >=60	19	17.1	19.0		0.900
Inventory age <80	6	11.9	9.8		1.216
Inventory age >=80	19	17.1	19.4		0.882
60<=Inventory age<120	12	17.3	18.2		0.948
Balsam	25	15.5	15.8	0.725	0.981
Inventory age <=120	8	10.2	8.5	0.667	1.210
Inventory age >120	17	18.0	19.3	0.474	0.933
Inventory age <60	3	6.4	7.3		0.879
Inventory age >=60	22	16.8	17.0		0.987
Aspen/Poplar	58	19.9	20.5	0.457	0.975
Inventory age <=80	23	17.3	16.1	0.434	1.070
Inventory age >80	35	21.7	23.3	0.151	0.931
Inventory age <60	11	14.8	12.8		1.151
Inventory age >=60	47	21.1	22.2		0.951
White Spruce	11	22.8	22.3	0.545	1.024
Inventory age <=120	2	23.7	19.5	1	1.217
Inventory age >120	9	22.6	22.9	0.267	0.988
Inventory age <60	1	14.7	10.0		1.473
Inventory age >=60	10	23.6	23.5		1.005
Black Spruce, Larch, StkCls 4 Pl	10[5]	13.7	14.3	0.163	0.957

[4] The strata are determined from the leading species indicated by the inventory (i.e. map label).

[5] There were no samples in this stratum > 60 years of age.

Table 3: Age adjustment ratios (ratio of means), by strata. "Non-productive forest" samples (typeid=6) excluded.

Strata	*n*	Age adjustment: Ratio of means			
		Mean ground age	Mean inventory age	Correlation	Ratio of means
Lodgepole pine (except StkCls 4)	25	98.6	104.5	0.749	0.944
Inventory age <=120	18	84.2	85.7	0.670	0.983
Inventory age >120	7	135.6	152.9	0.243	0.887
Inventory age <60	5	43.2	46.2		0.934
Inventory age >=60	20	112.4	119.1		0.944
Inventory age <80	6	47.1	51.2		0.920
Inventory age >=80	19	114.8	121.3		0.947
60<=Inventory age<120	13	100.0	100.8		0.991
Balsam	25	152.1	161.8	0.579	0.940
Inventory age <=120	8	83.4	75.6	0.608	1.102
Inventory age >120	17	184.4	202.4	-0.472	0.911
Inventory age <60	3	44.8	42.0		1.066
Inventory age >=60	22	166.7	178.2		0.935
Aspen/Poplar	67	72.3	80.8	0.501	0.895
Inventory age <=80	29	62.2	54.8	0.700	1.135
Inventory age >80	38	80.1	100.7	0.027	0.795
Inventory age <60	15	47.2	38.2		1.235
Inventory age >=60	52	79.6	93.1		0.855
White Spruce	13	133.8	166.5	0.514	0.804
Inventory age <=120	2	80.9	85.0	1	0.952
Inventory age >120	11	143.4	181.4	0.213	0.791
Inventory age <60	1	24.4	50		0.488
Inventory age >=60	12	142.9	176.3		0.811
Black Spruce, Larch, StkCls 4 Pl	11	95.5	106.3	0.332	0.899

Table 4: Loss Factor Volume adjustment ratios (ratio of means), by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[6] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume adjustment: Ratio of means				
		Mean ground vol/ha	Compiler Util'n	Mean "attribute-adj'd" inventory vol/ha	Inventory Util'n	Ratio of means
Lodgepole pine (except StkCls 4)	27	164.764	12.5cm+	139.585	12.5cm+	1.180
Inventory age <=120	20	163.013		132.375		1.231
Inventory age >120	7	169.766		166.529		1.019
Lodgepole pine (except StkCls 4)	27	188.125	9.0cm+	139.585	12.5cm+	1.348
Inventory age <=120	20	184.142		132.375		1.391
Inventory age >120	7	199.504		166.529		1.198
Balsam (17.5cm+)	25	122.072	17.5cm+	109.940	17.5cm+	1.110
Inventory age <=120	8	48.22		49.287		0.978
Inventory age >120	17	156.826		136.424		1.150
Aspen/Poplar (12.5cm+)	76	154.932	12.5cm+	111.543	12.5cm+	1.389
Inventory age <=80	35	113.064		79.794		1.417
Inventory age >80	41	190.674		141.759		1.345
White Spruce (17.5cm+)	17	219.198	17.5cm+	218.682	17.5cm+	1.002
Inventory age <=120	5	243.824		262.62		0.928
Inventory age >120	12	208.938		217.542		0.960
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	11	120.704	Sb/L: 17.5cm+; Pl: 12.5cm+	61.709	Sb/L: 17.5cm+; Pl: 12.5cm+	1.956
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	11	168.432	Sb/L: 9.0cm+; Pl: 9.0cm+	70.873	Sb/L: 12.5cm+; Pl: 12.5cm+	2.377
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	11	134.58	Sb/L: 17.5cm+; Pl: 9.0cm+	61.709	Sb/L: 17.5cm+; Pl: 12.5cm+	2.181

[6] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

Table 4a: ***60 YEAR and other AGE BREAKS***. Loss Factor Volume adjustment ratios (ratio of means), by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[7] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume adjustment: Ratio of means				
		Mean ground vol/ha	Compiler Util'n	Mean "attribute-adj'd" inventory vol/ha	Inventory Util'n	Ratio of means
Lodgepole pine (except StkCls 4)	27	164.764	12.5cm+	139.585	12.5cm+	1.180
Inventory age <60	6	33.503		54.283		0.617
Inventory age >=60	21	202.267		161.962		1.249
Inventory age <80	7	49.853		65.000		0.767
Inventory age >=80	20	204.983		162.25		1.263
60<=Inventory age<120	14	218.517		163.071		1.340
Lodgepole pine (except StkCls 4)	27	188.125	9.0cm+	139.585	12.5cm+	1.348
Inventory age <60	6	53.786		54.283		0.991
Inventory age >=60	21	226.508		161.962		1.399
Balsam (17.5cm+)	25	122.072	17.5cm+	109.940	17.5cm+	1.110
Inventory age <60	3	16.340		14.433		1.132
Inventory age >=60	22	136.490		123.386		1.106
Aspen/Poplar (12.5cm+)	76	154.932	12.5cm+	111.543	12.5cm+	1.389
Inventory age <60	18	77.864		51.167		1.522
Inventory age >=60	58	178.850		131.252		1.363
White Spruce (17.5cm+)	17	219.198	17.5cm+	218.682	17.5cm+	1.002
Inventory age <60	1	114.697		0		undefined
Inventory age >=60	16	225.730		224.463		1.006
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	11	120.704	Sb/L: 17.5cm+; Pl: 12.5cm+	61.709	Sb/L: 17.5cm+; Pl: 12.5cm+	1.956
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	11	168.432	Sb/L: 9.0cm+; Pl: 9.0cm+	70.873	Sb/L: 12.5cm+; Pl: 12.5cm+	2.377
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	11	134.58	Sb/L: 17.5cm+; Pl: 9.0cm+	61.709	Sb/L: 17.5cm+; Pl: 12.5cm+	2.181

[7] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

Table 5: NVAF Volume adjustment ratios (ratio of means), by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[8] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume adjustment: Ratio of means				
		Mean ground vol/ha	Compiler Util'n	Mean "attribute-adj'd" inventory vol/ha	Inventory Util'n	Ratio of means
Lodgepole pine (except StkCls 4)	27	175.958	12.5cm+	139.585	12.5cm+	1.261
Inventory age <=120	20	172.829		132.375		1.306
Inventory age >120	7	184.898		166.529		1.110
Lodgepole pine (except StkCls 4)	27	200.357	9.0cm+	139.585	12.5cm+	1.435
Inventory age <=120	20	194.708		132.375		1.471
Inventory age >120	7	216.494		166.529		1.300
Balsam (17.5cm+)	25	145.156	17.5cm+	109.940	17.5cm+	1.320
Inventory age <=120	8	52.649		49.287		1.068
Inventory age >120	17	188.689		136.424		1.383
Aspen/Poplar (12.5cm+)	76	167.769	12.5cm+	111.543	12.5cm+	1.504
Inventory age <=80	35	118.622		79.794		1.487
Inventory age >80	41	209.724		141.759		1.479
White Spruce (17.5cm+)	17	241.228	17.5cm+	218.682	17.5cm+	1.103
Inventory age <=120	5	265.682		262.62		1.012
Inventory age >120	12	231.039		217.542		1.062
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	11	125.416	Sb/L: 17.5cm+; Pl: 12.5cm+	61.709	Sb/L: 17.5cm+; Pl: 12.5cm+	2.032
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	11	173.731	Sb/L: 9.0cm+; Pl: 9.0cm+	70.873	Sb/L: 12.5cm+; Pl: 12.5cm+	2.451
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	11	139.823	Sb/L: 17.5cm+; Pl: 9.0cm+	61.709	Sb/L: 17.5cm+; Pl: 12.5cm+	2.266

[8] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

Table 5a: ***60 YEAR and other AGE BREAKS.*** NVAF Volume adjustment ratios (ratio of means), by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[9] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume adjustment: Ratio of means				
		Mean ground vol/ha	Compiler Util'n	Mean "attribute-adj'd" inventory vol/ha	Inventory Util'n	Ratio of means
Lodgepole pine (except StkCls 4)	27	175.958	12.5cm+	139.585	12.5cm+	1.261
Inventory age <60	6	33.503		54.283		0.617
Inventory age >=60	21	216.617		161.962		1.337
Inventory age <80	7	51.435		65.000		0.791
Inventory age >=80	20	219.541		162.25		1.353
60<=Inventory age<120	14	232.477		163.071		1.426
Lodgepole pine (except StkCls 4)	27	200.357	9.0cm+	139.585	12.5cm+	1.435
Inventory age <60	6	53.786		54.283		0.991
Inventory age >=60	21	242.544		161.962		1.498
Balsam (17.5cm+)	25	145.156	17.5cm+	109.940	17.5cm+	1.320
Inventory age <60	3	16.107		14.433		1.116
Inventory age >=60	22	162.754		123.386		1.319
Aspen/Poplar (12.5cm+)	76	167.769	12.5cm+	111.543	12.5cm+	1.504
Inventory age <60	18	80.537		51.167		1.574
Inventory age >=60	58	194.841		131.252		1.484
White Spruce (17.5cm+)	17	241.228	17.5cm+	218.682	17.5cm+	1.103
Inventory age <60	1	112.283		0		undefined
Inventory age >=60	16	249.287		224.463		1.111
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	11	125.416	Sb/L: 17.5cm+; Pl: 12.5cm+	61.709	Sb/L: 17.5cm+; Pl: 12.5cm+	2.032
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	11	173.731	Sb/L: 9.0cm+; Pl: 9.0cm+	70.873	Sb/L: 12.5cm+; Pl: 12.5cm+	2.451
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	11	139.823	Sb/L: 17.5cm+; Pl: 9.0cm+	61.709	Sb/L: 17.5cm+; Pl: 12.5cm+	2.266

[9] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

Table 6: Loss Factor Volume Impact, by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[10] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume Impact: Ratio of means				
		Mean ground vol/ha	Compiler Util'n	Mean unadj'd" inventory vol/ha	Inventory Util'n	Ratio of means
Lodgepole pine (except StkCls 4)	27	164.764	12.5cm+	162.878	12.5cm+	1.012
Inventory age <=120	20	163.013		137.39		1.186
Inventory age >120	7	169.766		235.7		0.720
Lodgepole pine (except StkCls 4)	27	188.125	9.0cm+	162.878	12.5cm+	1.155
Inventory age <=120	20	184.142		137.39		1.340
Inventory age >120	7	199.504		235.7		0.846
Balsam (17.5cm+)	25	122.072	17.5cm+	114.344	17.5cm+	1.068
Inventory age <=120	8	48.22		29.413		1.639
Inventory age >120	17	156.826		154.312		1.016
Aspen/Poplar (12.5cm+)	76	154.932	12.5cm+	121.586	12.5cm+	1.274
Inventory age <=80	35	113.064		63.009		1.794
Inventory age >80	41	190.674		171.59		1.111
White Spruce (17.5cm+)	17	219.198	17.5cm+	211.547	17.5cm+	1.036
Inventory age <=120	5	243.824		185.94		1.311
Inventory age >120	12	208.938		222.217		0.940
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	11	120.704	Sb/L: 17.5cm+; Pl: 12.5cm+	71.145	Sb/L: 17.5cm+; Pl: 12.5cm+	1.697
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	11	168.432	Sb/L: 9.0cm+; Pl: 9.0cm+	79.69	Sb/L: 12.5cm+; Pl: 12.5cm+	2.114
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	11	134.58	Sb/L: 17.5cm+; Pl: 9.0cm+	71.145	Sb/L: 17.5cm+; Pl: 12.5cm+	1.892

[10] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

Table 6a: ***60 YEAR and other AGE BREAKS.*** Loss Factor Volume Impact, by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[11] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume Impact: Ratio of means				
		Mean ground vol/ha	Compiler Util'n	Mean unadj'd" inventory vol/ha	Inventory Util'n	Ratio of means
Lodgepole pine (except StkCls 4)	27	164.764	12.5cm+	162.878	12.5cm+	1.012
Inventory age <60	6	33.503		36.950		0.907
Inventory age >=60	21	202.267		198.857		1.017
Inventory age <80	7	49.853		38.829		1.284
Inventory age >=80	20	204.983		206.295		0.994
60<=Inventory age<120	14	218.517		180.436		1.211
Lodgepole pine (except StkCls 4)	27	188.125	9.0cm+	162.878	12.5cm+	1.155
Inventory age <60	6	53.786		36.950		1.456
Inventory age >=60	21	226.508		198.857		1.139
Balsam (17.5cm+)	25	122.072	17.5cm+	114.344	17.5cm+	1.068
Inventory age <60	3	16.340		22.100		0.739
Inventory age >=60	22	136.490		126.923		1.075
Aspen/Poplar (12.5cm+)	76	154.932	12.5cm+	121.586	12.5cm+	1.274
Inventory age <60	18	77.864		26.083		2.985
Inventory age >=60	58	178.850		151.224		1.183
White Spruce (17.5cm+)	17	219.198	17.5cm+	211.547	17.5cm+	1.036
Inventory age <60	1	114.697		0		Undefined
Inventory age >=60	16	225.730		224.769		1.004
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	11	120.704	Sb/L: 17.5cm+; Pl: 12.5cm+	71.145	Sb/L: 17.5cm+; Pl: 12.5cm+	1.697
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	11	168.432	Sb/L: 9.0cm+; Pl: 9.0cm+	79.69	Sb/L: 12.5cm+; Pl: 12.5cm+	2.114
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	11	134.58	Sb/L: 17.5cm+; Pl: 9.0cm+	71.145	Sb/L: 17.5cm+; Pl: 12.5cm+	1.892

[11] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

Table 7: NVAF Volume Impact (ratio of means), by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[12] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume Impact: Ratio of means				
		Mean ground vol/ha	Compiler Util'n	Mean unadj'd" inventory vol/ha	Inventory Util'n	Ratio of means
Lodgepole pine (except StkCls 4)	27	175.958	12.5cm+	162.878	12.5cm+	1.080
Inventory age <=120	20	172.829		137.39		1.258
Inventory age >120	7	184.898		235.7		0.784
Lodgepole pine (except StkCls 4)	27	200.357	9.0cm+	162.878	12.5cm+	1.230
Inventory age <=120	20	194.708		137.39		1.417
Inventory age >120	7	216.494		235.7		0.919
Balsam (17.5cm+)	25	145.156	17.5cm+	114.344	17.5cm+	1.269
Inventory age <=120	8	52.649		29.413		1.790
Inventory age >120	17	188.689		154.312		1.223
Aspen/Poplar (12.5cm+)	76	167.769	12.5cm+	121.586	12.5cm+	1.380
Inventory age <=80	35	118.622		63.009		1.883
Inventory age >80	41	209.724		171.59		1.222
White Spruce (17.5cm+)	17	241.228	17.5cm+	211.547	17.5cm+	1.140
Inventory age <=120	5	265.682		185.94		1.429
Inventory age >120	12	231.039		222.217		1.040
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	11	125.416	Sb/L: 17.5cm+; Pl: 12.5cm+	71.145	Sb/L: 17.5cm+; Pl: 12.5cm+	1.763
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	11	173.731	Sb/L: 9.0cm+; Pl: 9.0cm+	79.69	Sb/L: 12.5cm+; Pl: 12.5cm+	2.180
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	11	139.823	Sb/L: 17.5cm+; Pl: 9.0cm+	71.145	Sb/L: 17.5cm+; Pl: 12.5cm+	1.965

[12] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

Table 7a: ***60 YEAR and other AGE BREAKS.*** NVAF Volume Impact (ratio of means), by strata. Two alternative utilizations are shown for all lodgepole pine strata. Where 9.0 cm+ dbh utilization[13] is indicated, a 12.5 cm+ dbh utilization for the inventory volume was used in the ratio development.

Strata	*n*	Volume Impact: Ratio of means				
		Mean ground vol/ha	Compiler Util'n	Mean unadj'd" inventory vol/ha	Inventory Util'n	Ratio of means
Lodgepole pine (except StkCls 4)	27	175.958	12.5cm+	162.878	12.5cm+	1.080
Inventory age <60	6	33.653		36.950		0.911
Inventory age >=60	21	216.617		198.857		1.089
Inventory age <80	7	51.434		38.829		1.325
Inventory age >=80	20	219.541		206.295		1.064
60<=Inventory age<120	14	232.477		180.436		1.288
Lodgepole pine (except StkCls 4)	27	200.357	9.0cm+	162.878	12.5cm+	1.230
Inventory age <60	6	52.701		36.950		1.426
Inventory age >=60	21	242.544		198.857		1.220
Balsam (17.5cm+)	25	145.156	17.5cm+	114.344	17.5cm+	1.269
Inventory age <60	3	16.107		22.100		0.729
Inventory age >=60	22	162.754		126.923		1.282
Aspen/Poplar (12.5cm+)	76	167.769	12.5cm+	121.586	12.5cm+	1.380
Inventory age <60	18	80.537		26.083		3.088
Inventory age >=60	58	194.841		151.224		1.288
White Spruce (17.5cm+)	17	241.228	17.5cm+	211.547	17.5cm+	1.140
Inventory age <60	1	112.283		0		Undefined
Inventory age >=60	16	249.287		224.769		1.109
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (12.5cm+)	11	125.416	Sb/L: 17.5cm+; Pl: 12.5cm+	71.145	Sb/L: 17.5cm+; Pl: 12.5cm+	1.763
Black Spruce (9.0cm+), Larch (9.0cm+), StkCls 4 Pl (9.0cm+)	11	173.731	Sb/L: 9.0cm+; Pl: 9.0cm+	79.69	Sb/L: 12.5cm+; Pl: 12.5cm+	2.180
Black Spruce (17.5cm+), Larch (17.5cm+), StkCls 4 Pl (9.0cm+)	11	139.823	Sb/L: 17.5cm+; Pl: 9.0cm+	71.145	Sb/L: 17.5cm+; Pl: 12.5cm+	1.965

[13] The 9.0 cm+ dbh utilization was used to approximate a special utilization based on a 10.5 cm minimum stump dob at a 30cm stump height. When the samples were compiled at the 9.0 cm+ utilization, all species within a cluster used 9.0 cm+ dbh.

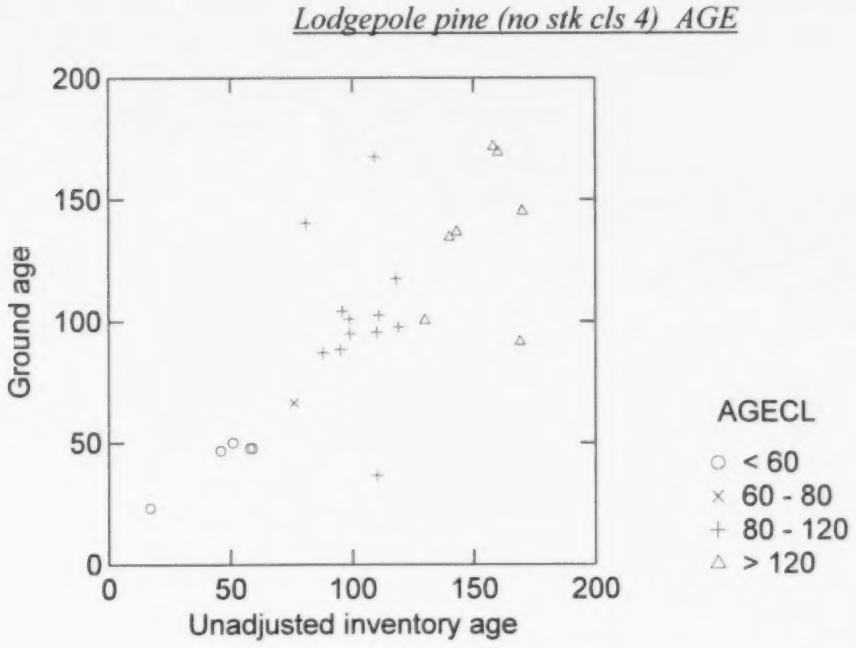


Fig 1: Ground vs map age relationship shown by inventory age grouping.

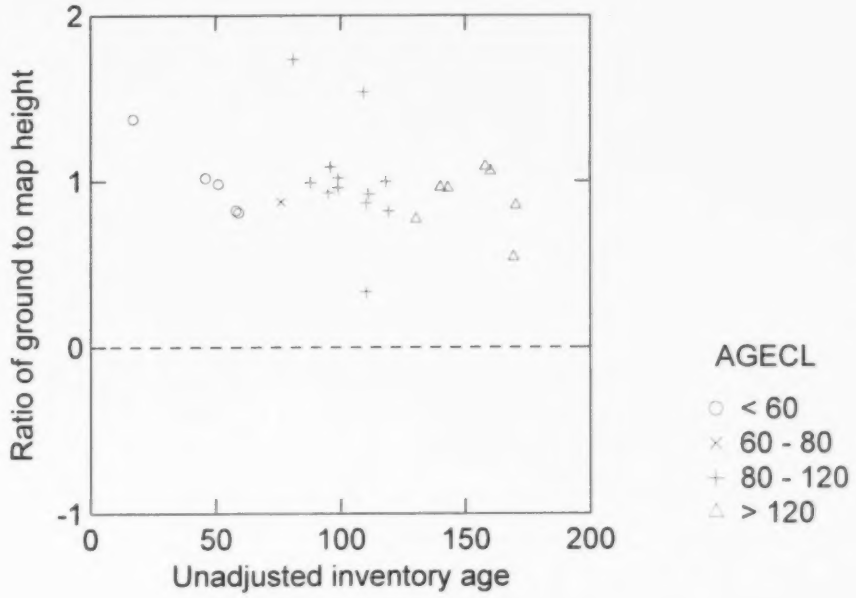


Fig. 2: Ratio of ground to inventory age (on a sample by sample basis) vs inventory age.

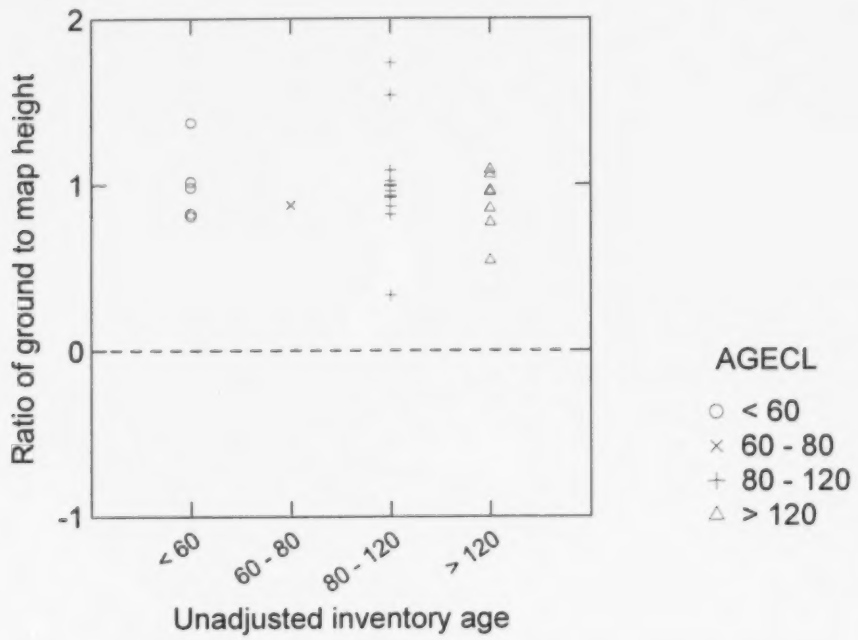


Fig. 3: Ratio of ground to inventory age (on a sample by sample basis) vs inventory age group.

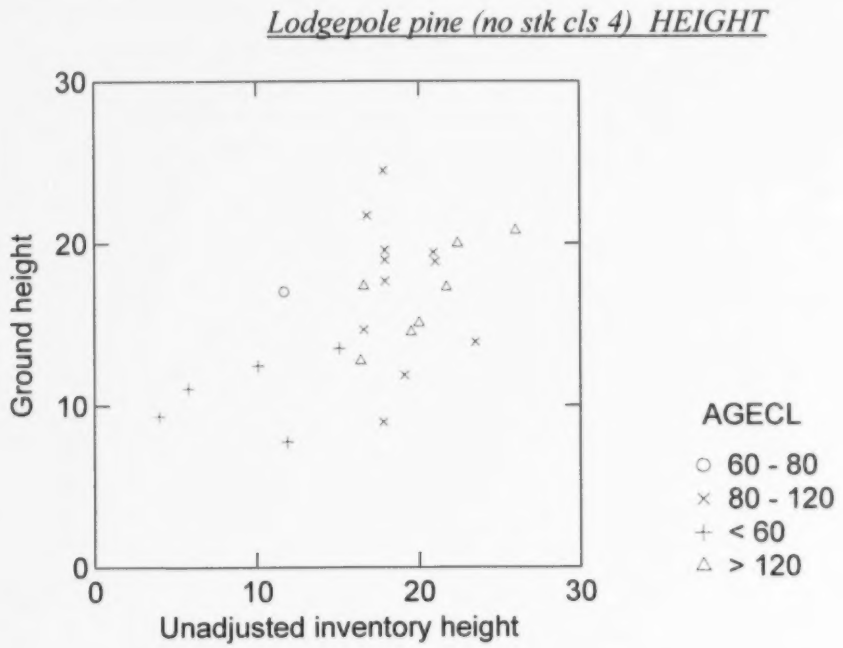


Fig 4: Ground vs map height relationship shown by inventory age grouping.

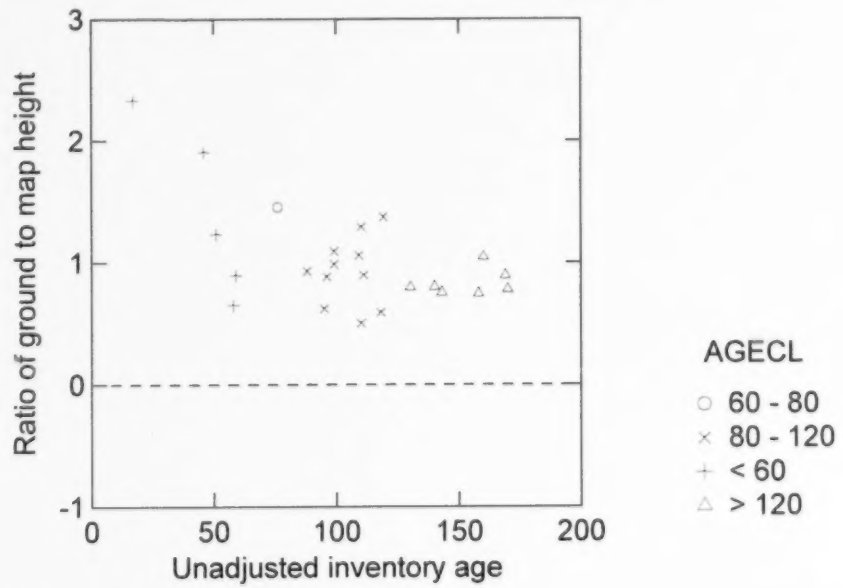


Fig. 5: Ratio of ground to inventory height (on a sample by sample basis) vs inventory age.

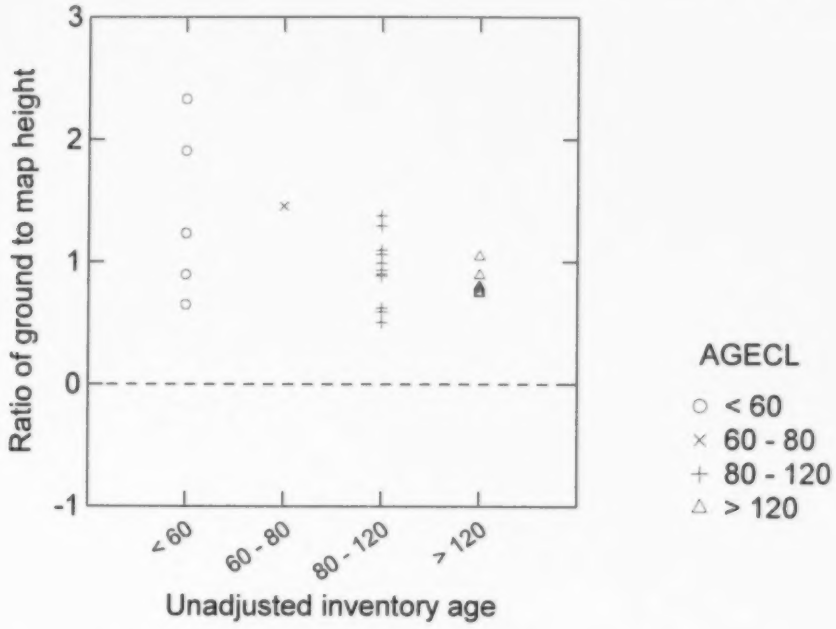


Fig. 6: Ratio of ground to inventory height (on a sample by sample basis) vs inventory age group.

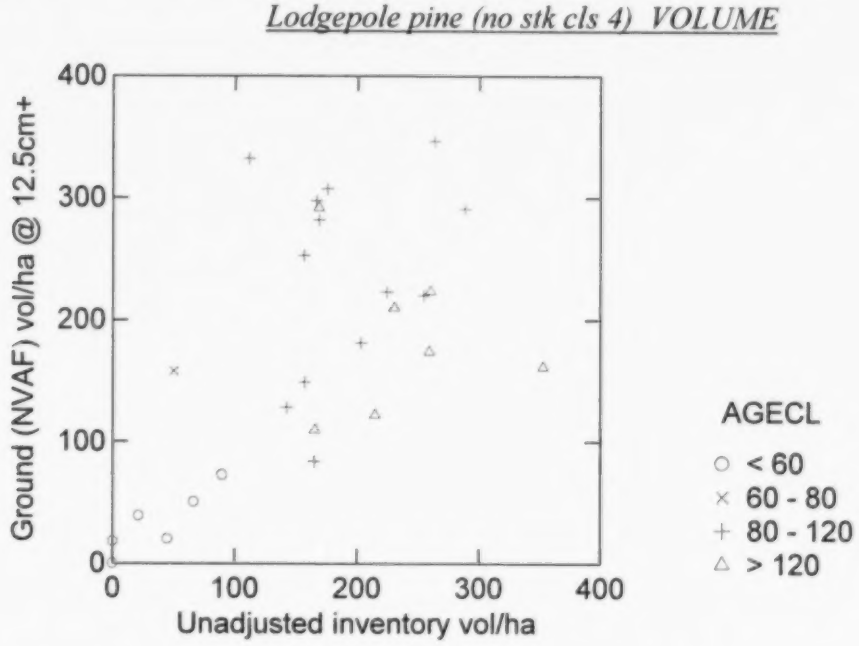


Fig 7: Ground vs inventory vol/ha relationship shown by inventory age grouping.

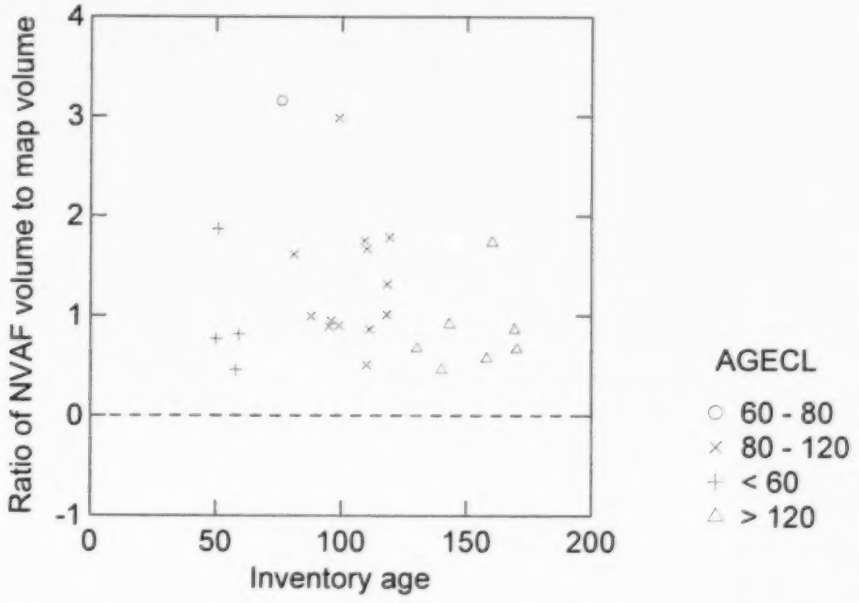


Fig. 8: Ratio of ground to inventory volume/ha (on a sample by sample basis) vs inventory age. Ground volume is NVAF at 12.5cm+ dbh net dwb.

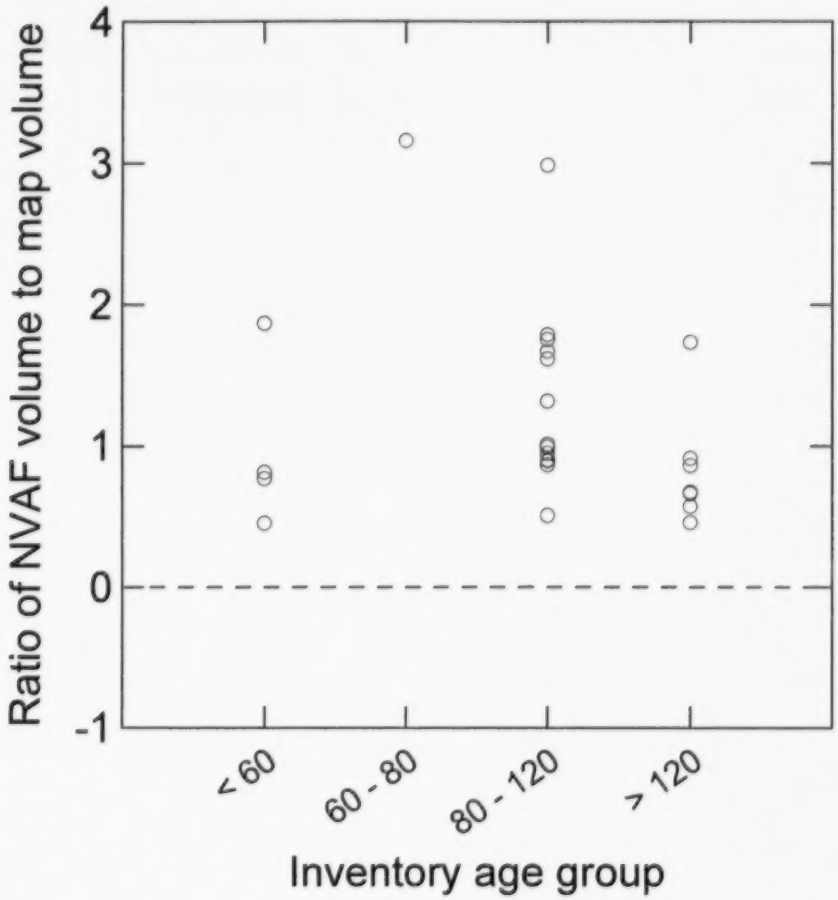


Fig. 9: Ratio of ground to inventory volume (on a sample by sample basis) vs inventory age group. Ground volume is NVAF at 12.5cm+ dbh net dwb.

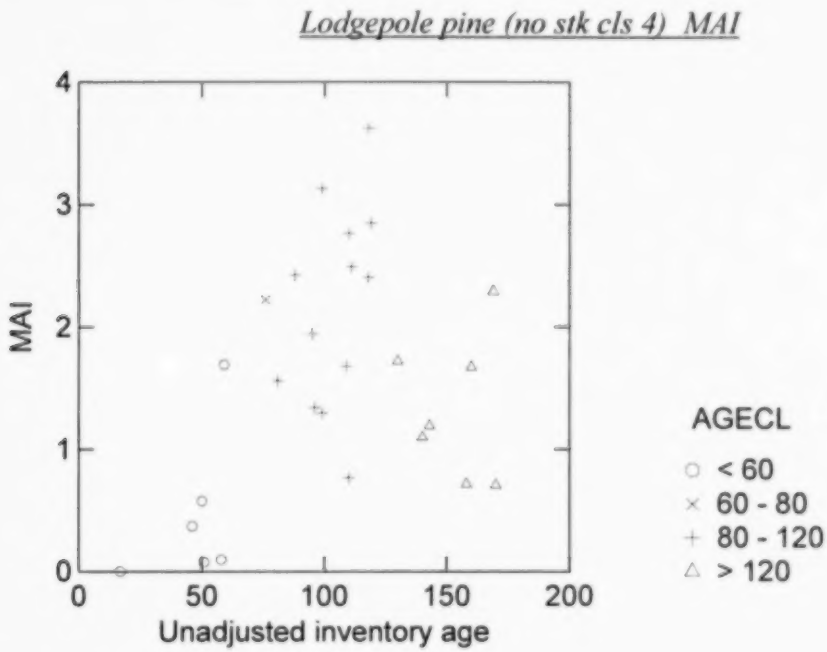


Fig 10: MAI vs inventory age.

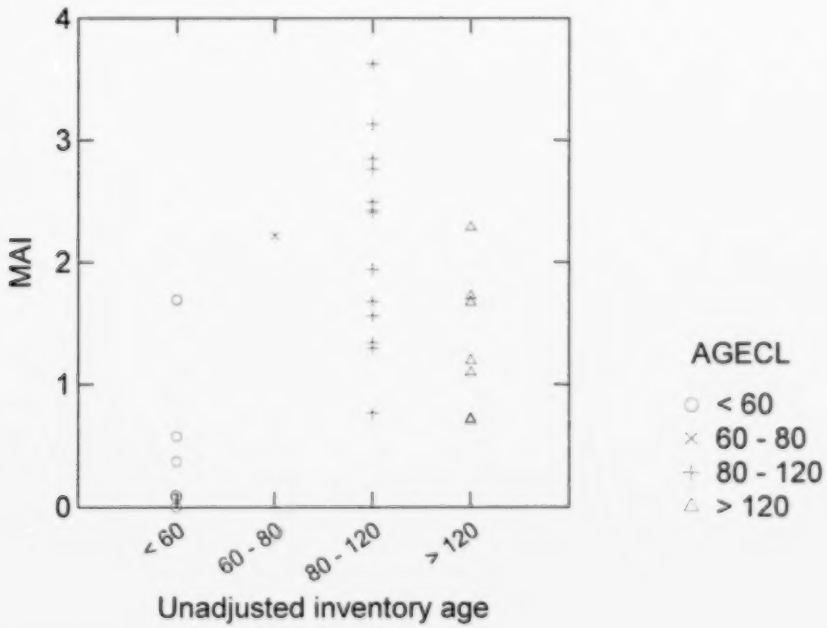


Fig. 11: MAI vs. inventory age, shown by age grouping.

Analysis Notes:

- Population of interest was VT, ownership codes 62C or 69C, excluding "non-productive forest" (i.e. typeid = 6)
- Heights and ages may have changed since previous analyses due to:
    - Change in methodology for matching ground and inventory heights and ages
    - Previous analysis used "expert opinion" to match appropriate heights and ages on a small number of samples..
- Volumes may have changed since previous analyses due to use of new "regression fix" compiler.
- NVAF has been completed in this unit and was applied to all samples (both loss factor and NVAF volume adjustment factors are provided)
- Volume adjustment factors were provided for several alternative utilizations, including a 9cm+ dbh utilization that was used to approximate a special utilization of 10.5 cm minimum stump dob at a 30cm stump height. When choosing among these alternative utilizations, care must be taken to use the correct VDYP utilization when generating the "attribute-adjusted" inventory volumes (see volume factor table for specifications).
- Species strata were further sub-stratified by age using a 120 year breakpoint (except 80 years in the deciduous stratum). The Sb/L/Pl 4 stratum was not sub-stratified by age since all but one sample was between 80 and 120 years of age.
- Graphs show volume utilization for lodgepole pine (i.e. 12.5 cm+ dbh compiler) and Sb/L/Pl 4 (i.e. mix of 17.5cm+ dbh and 12.5cm+ dbh for compiler) in volume plots